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VOL. XXXVI. No. 1 JANUARY, 1953

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MALAYAN AGRICULTURAL JOURNAL

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Kuala Lumpur.

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THE

Malayan Agricultural Journal

Edited by the Publications Officer with the assistance of
The Publications Committee.

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THE

Malayan Agricultural Journal

JANUARY, 1953.

EDITORIAL

Mechanisation of Wet Padi Cultivation. Experiments on the various problems of mechanisation of wet padi cultivation continue to be a major feature of the work of the Department of Agriculture, and persistent effort is being made in the analysis and solution of the problems which are included in the preparation of the land, sowing, weed control and harvesting.

Mr. P. G. Coleman's article on later pages on mechanisation experiments in Province Wellesley during the 1950-51 rice cultivation season, is a very interesting record of the way in which progress is being made, and emphasises, once again, the pre-eminent importance of water control.

Control of the Coconut Moth *Artona catoxantha* Hamps. This issue of the Journal contains some useful notes by Mr. Lever, the Entomologist, on outbreaks and methods of control of *Artona catoxantha* Hamps., a moth which is well-known in Malaya for the damage it does periodically to the leaves of coconut palms.

These notes show that outbreaks occur nearly three times as often in the first and drier half of the year as in the second half.

In his discussion of methods of control Mr. Lever points out that although some of the newer insecticides are toxic to *Artona* they are even more so to its parasites. It is the view of the Department of Agriculture that control by its natural enemies is still the best method of checking outbreaks of *Artona*.

Control of Diseases of Highland Vegetables. A minor but important agricultural industry in Malaya is that of vegetable cultivation at Cameron Highlands where the elevation varies between 3,000 and 5,000 feet above sea level. The industry started in the early 1930's, and by 1941 the estimated annual production had reached 4,000 tons. After the war production was intensified and by 1949 had reached 1,000 tons per month. Latest estimates put monthly production at 2,500 tons.

Although the climate at Cameron Highlands is favourable to the cultivation of vegetables it also favours the development of fungus

diseases, and in an article in this issue of the Journal Mr. Johnston, the Acting Senior Plant Pathologist, describes exploratory experiments that have been carried out with copper fungicides on four diseases of different vegetables.

Although it is not yet possible to give final recommendations, these preliminary experiments have shown that spraying with a copper fungicide is effective both in controlling certain diseases and in ensuring increased production.

WET PADI MECHANISATION INVESTIGATIONS IN PROVINCE WELLESLEY DURING THE 1950-51 SEASON

BY

P. G. COLEMAN,

Agricultural Officer, Kedah and Perlis.

Introduction.

By the end of the 1949-50 season, which has been reviewed in a previous article (1), a fairly considerable degree of success had been achieved towards the objective of developing equipment and methods suitable for the preparation of padi land in wet conditions. In the period now under consideration, the broader objective of complete mechanisation of padi growing was kept in mind, and so far as land preparation was concerned, attention was confined to detailed improvements and modifications to technique and equipment.

A certain degree of confidence was perhaps justified as regards land preparation, but it was obvious that there was still far to go in the direction of introducing the crop to the land, of keeping it reasonably free from weeds and of harvesting it. The main consideration which was kept in view was that a system of complete mechanisation must be evolved which would be suitable for application to areas where hand-labour would only be available in strictly limited numbers, and where the alternative to complete mechanisation would be no padi crop at all. The normal yardstick of hand-cultivation methods, i.e. in which all operations are performed by hand and hand-labour is abundant, was therefore ignored and it was decided that if cultivation was less thorough, plant populations less regularly distributed, weed growth was more abundant and harvesting losses were higher as a result of the adoption of mechanical methods, these considerations in themselves should not be allowed to condemn the latter methods as useless, uneconomic or unworthy of further attention.

Agronomic investigations were continued on similar lines to the previous season and consisted of three trials, namely Bukit Merah No. 7 —Depth and Double Cropping, Bukit Merah No. 9—Time and Depth of Cultivation, and Bukit Merah No. 10—Weed Control Observations.

Bukit Merah No. 7.

This experiment was designed to test the effect of deep and shallow cultivation on the yield of the off-season and the main season padi crops.

Treatments, which were duplicated, were as follows:—

Plots.	Off-Season.	Main Season.
3 & 6	Fallow	Buffalo cultivation.
1 & 5	Cultivation to 8 to 9 ins.	Cultivation to 8 to 9 ins.
2 & 4	Cultivation to 4 to 5 ins.	Cultivation to 4 to 5 ins.

OFF-SEASON, 1950.

Plots 1 to 5 were ploughed on the 10th April, 1950, with a Ferguson tractor fitted with wide, steel wheels at the rear and using a single-furrow, 16 ins. deep-digger mouldboard plough.

Conditions at ploughing were difficult and stoppages were fairly frequent, but the depth of ploughing was kept as nearly as possible between 8 and 9 ins.

Rolling of these plots was done on the 16th April, 1950, by an International T.D.6 tractor pulling the 18 ins. Mk. II Kedah-type roller; rolling was repeated on the 28th April, 1950.

On Plots 2 and 4, ploughing was carried out on the 6th April, 1950, by a Ransomes M.G.5 tractor pulling a T.S.42 single-furrow mouldboard plough. No difficulty was experienced and the depth was kept between 4 and 5 ins.

Rolling was done on the 22nd April, 1950, by the M.G.5 pulling a single drum-roller ballasted with 15 gallons of water; three rounds were made with the drum-roller.

On the 28th April, a final rolling was given using the M.G.5 and a single, Kedah-type roller.

Other details common to Plots 1, 2, 4 and 5 were as follows:—

3rd April:	Sowing. (Variety—Pe Bi Fun)
30th April:	Transplanting.
4th June:	Weeding.
20th June:	Weeding.
2nd August:	Harvesting.

Yields

Yields are given in lbs. per acre.

Deep.			Shallow.		
Plot No. 1	....	1,135	Plot No. 2	....	1,064
„ „ 5	....	1,111	„ „ 4	....	895
Treatment Mean	....	1,123	Treatment Mean	....	980

Plots 1 and 5 were very slightly damaged by the pest *Chenangau* (Leptocorisa).

Results.

Deep cultivation gave an increase in yield of the order of 15 per cent. over shallow cultivation but the difference was non-significant at the 5 per cent. point.

MAIN SEASON 1950-51.

Details of cultivation are given in Table I.

Plots were split for the treatments Weeding versus No Weeding, and weediness was estimated in man-hours weeding time for each sub-plot as follows:—

Table I.

Depth of Cultivation Experiment.

Bukit Merah No. 7.

Main Season 1950-51.

Plot Nos.	Treatments.	Date.	Operation.	Tractor.	Implement.	Wheels.
1 & 5	Deep plough.	14.8.50.	Plough 8 ins.	Ferguson.	1 x 16 ins. plough.	Tyre girdle.
	,, ,,	15.8.50.	Harrow.	Ferguson.	1-gang disc-harrow.	Tyre girdle.
	,, ,,	16.9.50.	Roll.	T.D. 6.	2 ft. triple steel roller.	Track.
	,, ,,	17.9.50.	Light slashing.	Hand labour.	*Tajak.*	—
2 & 4	Shallow plough.	7.8.50.	Plough 4 ins.	M.G. 5.	1 x 9 ins. trailer plough.	Track.
	,, ,,	16.8.50.	Harrow.	Ferguson.	1-gang disc-harrow.	Tyre girdle.
	,, ,,	16.9.50.	Roll.	T.D. 6.	2 ft. triple steel roller.	Track.
	,, ,,	17.9.50.	Light slashing.	Hand labour.	*Tajak.*	—
3 & 6	Buffalo (Control)	17.6.50.	Slashing.	Hand labour.	*Tajak.*	—
	,, ,,	2.9.50.	Plough.	Buffalo & hand labour.	Plough.	—
	,, ,,	11.9.50.	1st harrowing.	,, ,,	Local harrow.	—
	,, ,,	13.9.50.	2nd ,,	,, ,,	,, ,,	—
	,, ,,	15.9.50.	3rd ,,	,, ,,	,, ,,	—
	,, ,,	16.9.50.	4th ,,	,, ,,	,, ,,	—
	,, ,,	16.9.50.	Rolling.	,, ,,	Local wooden roller.	—
	,, ,,	17.9.50.	Light slashing.	,, ,,	*Tajak.*	—

Notes on Operations (all plots):—

5th Aug., 1950: Sowing. Variety—Radin Kelumbong.
18th Sept., 1950: Transplanting.
6th Nov., 1950: Weeding.
17th & 18th Dec., 1950: Flowering commenced.
5th & 6th Jan., 1951: Flowering ceased.
10th Feb., 1951: Harvesting in dry conditions.

General.

Water was adequate and well distributed.

Weediness in Man-Hours per Sub-plot of 0.04 Acre.

Deep	....	(Plots 1 and 5) =	5.3 man-hours.
Shallow	....	(„ 2 „ 4) =	5.9 „
Control (Buffalo)	....	(„ 3 „ 6) =	10.3 „

On the 23rd December, 1950, i.e. when the crop had started to flower, marks were awarded to each plot by visual examination under the headings Colour, Number of Tillers, Height and General Growth, the summary of marks allocated being as follows:—

Deep	....	(Plots 1 and 5)	86 per cent.
Shallow	....	(„ 2 „ 4)	84 „ „
Control (Buffalo)	....	(„ 3 „ 6)	68 „ „

Yields.

Damage to the crop from stem-borers and rats was somewhat severe and varied from 40 to 70 per cent., so that no great value can be placed on the actual yield figures, which are summarised below:—

Treatment Means in Lbs. per Acre.

Deep	....	....	(Plots 1 and 5) =	978
Shallow	....	....	(„ 2 „ 4) =	856
Control (Buffalo)	....	....	(„ 3 „ 6) =	719

Discussion.

Owing to pest damage and to the small number of replications, yield figures were of little value, but pre-harvest observations were indicative of yield results and trends were quite consistent, showing deep cultivation to be better than shallow, and both better than buffalo cultivation.

Buffalo-cultivated plots were markedly more weedy than mechanical plots.

Bukit Merah No. 9.

This trial was designed to test the effect on the yield of padi of cultivating at different times and depths.

Treatments were as follows:—

Plot 1.	Deep	(8 ins.)	and Early	(April).
2.	Shallow	(4 „)	and Early	(April).
3.	Shallow	(4 „)	and Late	(September).
4.	Deep	(8 „)	and Normal	(June).
5.	Shallow	(4 „)	and Normal	(June).
6.	Control	(Buffalo).		
7.	Deep	(8 ins.)	and Late	(September).

Plot size was 1/10 acre and plots were split for weeding versus no weeding; since, however, treatments were unreplicated this trial can be regarded only as an observation.

Details of cultivations are given in Table II, and of yields and weediness in Table III.

Table II.

Time and Depth Experiment.

Bukit Merah No. 9.

Main Season 1950-51. Details of Cultivations.

Plot No.	Treatment.	Date.	Operation.	Tractor.	Implement.	Wheels.	Remarks.
1	Deep & early.	24. 4.50.	Plough 8 ins	Ferguson	1 x 16 ins. plough	Extension steel	Moist conditions.
		24. 4.50.	-do.-	- do.-	-do.-	Tyre girdle	-do.-
		26-27. 4.50.	-do.-	Fordson	2 x 12 ins. trailer	P.W. solid, closed extension	-do.-
		14. 9.50.	Roll	T.D. 6....	2 ft. triple steel roller	Tracks	6 to 8 ins. water.
		15. 9.50.	-do.-	-do.-	-do.-	-do.-	-do.-
		26. 9.50.	-do.-	-do.-	1½ ft. triple steel roller	-do.-	-do.-
		2.10.50.	-do.-	Farmall	-do.-	Wide front axle enclosed steel. Rear: 4 ins. P.W. solid, enclosed.	-do.-
		3.10.50.	Light slashing	Hand labour	*Tajak*	—	-do.-
2	Shallow & early.	24. 4.50.	Plough 4 ins.	M.G. 5	1 x 9 ins. plough	Tracks	Moist conditions.
		14. 9.50.	Roll	T.D. 6	2 ft. triple steel roller	-do.-	6 to 8 ins. water.
		15. 9.50.	-do.-	-do.-	-do.-	-do.-	-do.-
		26. 9.50.	-do.-	-do.-	1½ ft. triple steel roller	-do.-	-do.-
		2.10.50.	-do.-	Farmall	-do.-	Wide front axle enclosed steel. Rear: 4 ins. P.W. solid, enclosed.	-do.-
		3.10.50.	Light slashing	Hand labour	*Tajak*	—	-do.-
3	Shallow & late.	26. 9.50.	Plough 4 ins.	M.G. 5	1 x 9 ins. plough	Tracks	2 to 4 ins. water.
		29. 9.50.	Roll.	Farmall	1½ ft. triple steel roller	Wide front axle enclosed steel. Rear: 4 ins. P.W. solid, enclosed.	6 to 8 ins. water.
		2.10.50.	Roll	-do.-	-do.-	-do.-	-do.-
		3.10.50.	Light slashing	Hand labour	*Tajak*	—	-do.-
4	Deep & normal.	1. 7.50.	Plough 8 ins.	Ferguson	1 x 16 ins. plough	Extension steel	Moist conditions
		3. 7.50.	-do.-	-do.-	-do.-	-do.-	Dry
		14. 9.50.	Roll.	T.D. 6	2 ft. triple steel roller	Tracks	6 to 8 ins. water.
		15. 9.50.	-do.-	-do.-	-do.-	do.-	-do.-
		26. 9.50.	-do.-	-do.-	1½ ft. triple steel roller	-do.-	-do.-

						steel. Rear: 4 ins. P.W. solid, enclosed.	-do.-
		3.10.50.	Light slashing	Hand labour	*Tajak*	—	-do.-
5	Shallow and normal.						
		30. 6.50.	Plough 4 ins.	M.G. 5	1 x 9 ins. plough	Track	Moist conditions
		14. 9.50.	Roll.	T.D. 6	2 ft. triple steel roller	-do.-	6 to 8 ins. water.
		15. 9.50.	-do.-	-do.-	-do.-	-do.-	-do.-
		26. 9.50.	-do.-	-do.-	1½ ft. triple steel roller	-do.-	-do.-
		1.10.50.	-do.-	Farmall	-do.-	Wide front axle enclosed steel. Rear: 4 ins. P.W. solid, enclosed.	-do.-
		3.10.50.	Light slashing	Hand labour	*Tajak*	—	-do.-
6	Buffalo and normal.						
		19. 6.50.	Light slashing	Hand labour	*Tajak*	—	Dry conditions.
		22. 6.50.	Plough	Buffalo	*Kampong* plough	—	Moist conditions
		7. 9.50.	Replough	-do.-	-do.-	—	2 to 4 ins. water
		14. 9.50.	1st harrowing	-do.-	*Kampong* harrow	—	-do.-
		18. 9.50.	2nd -do.-	-do.-	-do.-	—	-do.-
		22. 9.50.	3rd -do.-	-do.-	-do.-	—	-do.-
		26. 9.50.	4th -do.-	-do.-	-do.-	—	-do.-
		1.10.50.	Roll.	-do.-	-do.-	—	-do.-
		2.10.50.	Light slashing	Hand labour	*Tajak*	—	-do.-
7	Deep and late.	26. 9.50.	Plough 8 ins.	Ferguson	1 x 16 ins. plough	Extension steel	2 to 4 ins. water
		29. 9.50.	Roll.	Farmall	1½ ft. triple steel roller	Wide front axle enclosed steel. Rear: 4 ins. P.W. solid, enclosed.	6 to 8 ins. water
		2.10.50.	Roll.	Farmall	-do.-	-do.-	6 to 8 ins. water
		3.10.50.	Light slashing	Hand labour	*Tajak*	—	-do.-

Notes on Operations (all plots):—

13th August, 1950: Sowing—Variety Radin Kelumbong.
5th October, 1950: Transplanting.
14th November, 1950: Weeding.
26th-28th December, 1950: Flowering commenced.
15th-17th January, 1951: Flowering ceased.
15th February, 1951: Harvesting.

General.

Water was adequate and well distributed. Harvesting in dry conditions. No pests or disease.

Table III.

Time and Depth Experiment.

Bukit Merah No. 9.

Main Season 1950-51. Yields and Weediness.

(Size of each plot 1|10 acre. (Sub-plots 1|20 Weeded, 1|20 Not Weeded)).

No.	Treatment.	Weeded.			Not Weeded.	Average Yield per Acre.
		Yield per acre.	Time of weeding a 1/20 acre plot.		Yield per acre.	
		lbs.	hrs.	mins.	lbs.	lbs.
1	Deep and early	1,763	7	44	1,421	1,592
2	Shallow and early	1,669	7	52	1,359	1,514
3	Shallow and late	1,288	6	32	1,093	1,191
4	Deep and normal	1,481	4	8	1,113	1,297
5	Shallow and normal	2,219	6	40	1,668	1,944
6	Buffalo and normal	2.099	9	44	1,565	1,832
7	Deep and late	1,408	6	48	1,225	1,317
	Mean	1,704			1,349	1,527

Treatment means.

(in lbs. per acre)

Deep (1, 4, 7)	1,402
Shallow (2, 3, 5)	1,549
Buffalo	1,832
Early (1, 2)	1,553
Normal (4, 5)	1,621
Late (3, 7)	1,254

Per Cent. Reduction in Yield from Weediness.

Plot	Reduction
1	20
2	18
3	15
4	24
5	24
6	25
7	13

Observations.

(1) Shallow (4 ins.) better than deep (8 ins.)

(2) Normal (June) better than early (April) and late (September).

Bukit Merah No. 10.

This trial was laid down in 1949 to observe differences in weediness and yields resulting from different types and degrees of mechanical cultivation; in the season under review, the number of "treatments" was increased from five to nine, with buffalo cultivation as a control in each case.

Treatments, which were unreplicated, were as follows:—

1. "Paddle unit" cultivation only.
2. Plough (to 8 ins.), disc-harrow.
3. Plough (to 8 ins.), roll.
4. Rotary cultivation (to 4 ins.), roll.
5. Plough (to 8 ins.), disc-harrow, roll.
6. Roll only.
7. Plough (to 15 ins.), disc-harrow, roll.
8. Plough (to 4 ins.), disc-harrow, roll.
9. Chisel (to 15 ins.), plough (to 8 ins.), disc-harrow, roll.
10. Buffalo plough, harrow, roll.

Plot size was ½ x 2 chains (1/10 acre), with ½ or ¼ chain discards between plots, according to availability of land.

Details of cultivations are given in Table IV, yields and weediness in Table V, and markings on observation in Table VI.

Discussion.

It is unsafe to draw any conclusion from these unreplicated treatments, more particularly since there appeared to be a fertility trend favouring the eastern end of the block, i.e. plots 7, 8 and 9, but certain indications may be noted.

1. *Yields.*
   (a) No apparent harm has resulted from ploughing down to 15 ins. and bringing up raw clay (Plot 7).
   (b) Chiselling may have assisted root penetration (Plot 9).
   (c) There appears to have been no marked difference between superficial cultivation (Plots 1 and 6) and soil inversion (Plots 2, 3, 4 and 5). Plots 7, 8 and 9 have been disregarded, for comparison, due to the fertility trend.

2. *Weediness.*
   (a) "Paddle only" cultivation (Plot 1) resulted in remarkably little weed growth.
   (b) It is difficult to explain the high degree of weediness from 15 ins. ploughing (Plot 7) and 4 ins. ploughing (Plot 8) as compared with the small amount of weediness in Plot 9 (chisel), all three plots being within the "high fertility" area.

Table IV.
Weed Control Observations.
Bukit Merah No. 10.
Details of Cultivations.

Plot No.	Treatment.	Date.	Operation.	Tractor.	Implement.	Wheels.	Remarks.
1	Paddle only	12.9.50.	Paddle	Farmall	Front and rear paddle only.	Paddle.	4 to 6 ins. water.
		21.9.50.	-do.-	-do.-	-do.-	-do.-	
2	Plough 8 ins. & disc-harrow.	27.7.50.	Plough	Fordson	Mc.D. 2 x12 ins. trailer.	P.W. solid, closed extension with 6 ins. strakes.	Dry conditions.
		15.8.50.	Harrow	T.D. 6	½-gang Baron disc-harrow.	Tracks.	6 to 8 ins. water.
		18.9.50.	-do.-	Fordson	½-gang Mc.D. light disc-harrow.	P.W. solid, closed extension with 6 ins. strakes.	-do.-
		20.9.50.	-do.-	-do.-	-do.-	-do.-	-do.-
3	Plough 8 ins. & roll	27.7.50.	Plough	Fordson	Mc.D. 2 x12 ins. trailer.	-do.-	Dry conditions.
		18.9.50.	Roll	-do.-	1½ ft. triple steel roller.	-do.-	6 to 8 ins. water.
		20.9.50.	-do.-	-do.-	-do.-	-do.-	-do.-
		25.9.50.	-do.-	T.D. 6	-do.-	Tracks.	-do.-
4	Tillmor 4 ins. & roll.	8.9.50.	Rotary	Fordson	Tillmor.	P.W. solid, closed extension with 6 ins. strakes.	4 to 6 ins. water.
		18.9.50.	Roll	-do.-	1½ ft. triple steel roller.	-do.-	6 to 8 ins. water.
		20.9.50.	-do.-	-do.-	-do.-	-do.-	-do.-
		25.9.50.	-do.-	T.D. 6	-do.-	Tracks.	-do.-
5	Plough 8 ins., disc-harrow & roll.	27.7.50.	Plough	Fordson	Mc.D. 2 x12 ins. trailer.	P.W. solid, closed extension with 6 ins. strakes.	Dry conditions.
		15.8.50.	Harrow	-do.-	1-gang Mc.D. light disc-harrow.	Rubber.	-do.-
		18.9.50.	Roll	-do.-	1½ ft. triple steel roller.	P.W. solid, closed extension with 6 ins. strakes.	6 to 8 ins. water
		20.9.50.	-do.-	-do.-	-do.-	-do.-	-do.-
		25.9.50.	-do.-	T.D. 6	-do.-	Tracks.	-do.-
6	Roll only.	18.9.50.	Roll	Fordson	1½ ft. triple steel roller.	P.W. solid, closed extension with 6 ins. strakes.	6 to 8 ins. water
		20.9.50.	-do.-	-do.-	-do.-	-do.-	-do.-
		25.9.50.	-do.-	T.D. 6	-do.-	Tracks.	-do.-

Table IV Cont'd.

Plot No.	Treatment.	Date.	Operation.	Tractor.	Implement.	Wheels.	Remarks.
7	Deep plough 15 ins., disc-harrow, and roll.	27.7.50.	Plough	T.D. 6	Mc. D. 2 x 16 ins. trailer.	Track	Dry conditions.
		28.7.50.	Harrow	-do.-	1-gang Baron disc-harrow.	-do.-	-do.-
		18.9.50.	Roll	Fordson	1½ ft. triple steel roller.	P.W. solid, closed extension with 6 ins. strakes.	6 to 8 ins. water
		20.9.50.	-do.-	-do.-	-do.-	-do.-	-do.-
		25.9.50.	-do.-	T.D. 6	-do.-	Tracks.	-do.-
8	Shallow plough 4 ins., disc-harrow & roll.	27.7.50.	Plough	M.G. 5	Single furrow plough.	Tracks.	Dry conditions.
		15.8.50.	Harrow	Fordson	1-gang Mc.D. light disc-harrow.	Rubber.	-do.-
		18.9.50.	Roll	-do.-	1½ ft. triple steel roller.	P.W. solid, closed extension with 6 ins. strakes.	6 to 8 ins. water
		20.9.50.	-do.-	-do.-	-do.-	-do.-	-do.-
		25.9.50.	-do.-	T.D. 6	-do.-	Tracks.	-do.-
9	Chisel 15 ins., plough 8 ins., disc-harrow & roll.	26.7.50.	Chisel	Ferguson	Chisel.	Tyre girdle.	Dry conditions.
		27.7.50.	Plough	-do.-	16 ins. mouldboard plough	-do.-	-do.-
		15.8.50.	Harrow	Fordson	1-gang Mc.D. light disc-harrow.	Rubber wheel.	-do.-
		18.9.50.	Roll	-do.-	1½ ft. triple steel roller.	P.W. solid, closed extension with 6 ins. strakes.	6 to 8 ins. water
		20.9.50.	-do.-	-do.-	-do.-	-do.-	-do.-
		25.9.50.	-do.-	-do.-	-do.-	-do.-	-do.-
10	Buffalo.	9.9.50.	Plough	Buffalo	Buffalo plough.	—	Moist conditions
		14.9.50.	1st Harrowing	-do.-	Buffalo harrow.	—	4 to 6 ins. water.
		18.9.50.	2nd Harrowing	-do.-	-do.-	—	6 to 8 ins. water
		22.9.50.	3rd Harrowing	-do.-	-do.-	—	-do.-
		25.9.50.	4th Harrowing	-do.-	-do.-	—	-do.-
		26.9.50.	Roll	-do.-	Buffalo roller.	—	-do.-
		26.9.50.	Light Slashing	Man	*Tajak*.	—	-do.-

NOTE:—Mc.D. - McCormick Deering.

Table V.

Weed Control Observations.

Bukit Merah No. 10.

Main Season 1950-51. Yields and Weediness.

(Size of each plot 1/10 acre. Variety planted: Radin Kelumbong.)

Plot No.	Treatment.	Weeded.				Not Weeded.		Average Yield per Acre.
		Yield per acre.	Rat damage.	Weeding times per plot of 1/20 acre.		Yield per acre.	Rat damage.	
		lbs.	per cent.	hrs.	mins.	lbs.	per cent.	lbs.
1.	Paddle only	1,724	5	1	30	1,333	—	1,529
2.	Plough (8 ins.) and disc-harrow	1,924	—	3	10	1,418	10	1,671
3.	Plough (8 ins.) and roll	1,765	—	2	40	1,399	—	1,582
4.	Tillmor (4 ins.) and roll	1,633	—	2	50	1,119	20	1,371
5.	Plough (8 ins.), disc-harrow and roll	2,235	—	3	10	1,595	30	1,915
6.	Roll only	1,964	—	2	50	1,348	20	1,656
7.	Deep plough (15 ins.), disc-harrow and roll	2,345	10	3	50	2,019	5	2,182
8.	Shallow plough (4 ins.), disc-harrow and roll	2,214	5	3	10	1,786	15	2,000
9.	Chisel 15 ins., plough (8 ins.), disc-harrow and roll	2,493	—	1	10	1,904	10	2,199
10.	Buffalo	1,733	5	1	40	1,430	—	1,582
	Mean	2,002	—			1,535	—	1,769

Table VI.

Weed Control Observations.

Bukit Merah No. 10.

Main Season 1950-51. Marks on Observation.

(Taken on 23rd December, 1950.)

Plot Nos.	1	2	3	4	5	6	7	8	9	10
Treatments.	Paddle only.	Plough and disc-harrow.	Plough and roll.	Tillmor and roll.	Plough, harrow and roll.	Roll only.	Deep plough, harrow and roll.	Shallow plough, harrow and roll.	Chisel, inter-plough, harrow and roll.	Buffalo.
Colour	19.00	19.50	19.50	19.00	20.00	19.50	20.00	20.00	20.00	18.00
Tillers	9.15	9.95	9.35	9.15	12.20	10.40	12.50	12.25	12.20	8.90
Height	15.00	18.50	18.00	15.00	19.50	18.00	20.00	20.00	20.00	16.50
General growth	13.50	16.50	17.50	13.50	19.00	17.50	20.00	20.00	20.00	13.50
Total	56.65	64.45	64.35	56.65	70.70	65.40	72.50	72.25	72.20	56.90

Visual estimates of per cent. weed growth in the unweeded sub-plots (after harvesting).

1.	Paddle only	18.3
2.	Plough and disc-harrow	61.7
3.	Plough and roll	33.3
4.	Tillmor and roll	38.3
5.	Inter-plough, harrow and roll	45.0
6.	Roll only	30.0
7.	Deep plough, harrow and roll	23.3
8.	Shallow plough, harrow and roll	33.3
9.	Chisel, inter-plough, harrow and roll	33.3
10.	Buffalo	35.0

(c) In all unweeded sub-plots yields were reduced (varying between 14 and 31 per cent.).

3. *Damage.*

As was to be expected, rat damage was markedly higher in the unweeded than in the weeded sub-plots.

Summary.

In these observations on extremes of cultivation methods, varying from rolling or paddling only to complete cultivation by ploughing, harrowing and rolling, there is insufficient evidence to indicate that the standard practice of ploughing and rolling requires revision, particularly in view of the fact that the standard method is capable of application over a very wide range of soil and water conditions, whereas some of the "treatments" employed in this trial can only be applied where conditions of water supply are under very close control.

Summary of Agronomic Investigations.

Bukit Merah No. 7—Depth and Double-Cropping—which was the only trial in which treatments were duplicated confirmed the results of the two previous seasons, i.e. in the off-season, deep was better than shallow cultivation, and, in the main season, mechanical was better than buffalo cultivation.

Bukit Merah No. 9—Time and Depth of Cultivation—although unreplicated, indicated for the first time that buffalo cultivation was better than mechanical, and that shallow was better than deep cultivation. In previous seasons, no wide differences have shown up and it is probable that differences in effectiveness of cultivation carried out at different times has had an overiding influence on the effect of depth of cultivation.

As in previous seasons, cultivation at the normal time was better than both early and late cultivations.

Trial Bukit Merah No. 10.—Weed Control Observations—cannot be compared with the previous season since all but three of the treatments were introduced for the first time and, apart from being unreplicated, it was found that the newly added area, used for the first time as an extension to accommodate additional treatments, was of higher fertility than the rest of the area.

Engineering Developments.

Engineering developments were confined to detail refinements and minor modifications to existing equipment, and no new equipment was received for test during the period under review.

Explorations.

Explorations were directed, as already indicated, to finding or improving methods for:—

1. Sowing.
2. Weed control.
3. Harvesting.

The greatest progress was made under the first heading, and a large-scale observation trial was conducted which demonstrated the feasibility of broadcasting padi seed on the water, after normal (mechanical) land-preparation such as is required for hand transplanting.

BROADCASTING TRIAL.

A large field at Bukit Merah Padi Experiment Station, Province Wellesley, was divided into seven, one-acre plots, the whole area having been mechanically cultivated and having an average of 3 to 4 ins. of water on the surface. Each plot was sown (variety: Radin Kelumbong) by one of the following methods:—

Plot.	Motive Power.	Method of Application.
1.	Ferguson tractor	Hand
2.	- do -	Fiddle
3.	Farmall 'H' tractor	Hand
4.	Man	Hand
5.	T.D.6 tractor	Fiddle
6.	T.D.6 tractor	Hand
7.	Man	Fiddle

Whenever a tractor supplied the motive power, a man was stationed on a simple platform mounted behind the driver. When broadcasting by hand, the sower was supplied with a shallow tray containing the seed, which was suspended by a strap round his neck so that both hands were left free for scattering the seed. The fiddle consisted of a simple spinner operated by drawing a "bow" to and fro across a wooden spindle, the seed being contained in a canvas hopper and the rate of flow on to the spinner being controlled by an adjustable slide.

The dimensions of each plot were 1 x 10 chains and it had been found in previous trials that the width of a swathe spread by hand was approximately 11 ft. and by fiddle was 22 ft.; in order to cover a width of 1 chain, therefore, it was necessary to make six runs by hand or three runs by fiddle.

In the light of previous experience on smaller plots, a uniform seed-rate of 3½ gantangs * per acre was employed, using seed which had been soaked for 42 hours and then superficially dried for easier handling.

It was necessary to use first gear on the tractors to permit the sowers to scatter the seed at a comfortable, sustained rate by hand, but the faster action of the fiddle permitted second gear to be used with that instrument.

All plots were sown without any difficulty, but fairly considerable soil disturbance was caused by wheels and tracks in the tractor plots, i.e. Nos. 1, 2, 3, 5 and 6; in contrast, plots 4 and 7 were less disturbed than they would have been by hand transplanting.

Comparative times for sowing one acre were as follows:—

* 1 gantang = 1 gallon.

Plot.		Time.
1	(1st gear)	27 minutes
2	(2nd „)	13 „
3	(1st „)	24 „
4		42 „
5	(2nd „)	12½ „
6	(1st „)	45 „
7		21 „

After sowing, water was drained off the area to encourage germination and was gradually run on again from the 14th day after sowing, when shoots were between 1½ and 2 ins. long; keeping pace with the growth of the padi, the water level was slowly raised to an average of 4 to 6 ins.

Germination was satisfactory except in the ruts left by tractor wheels or tracks, where it was practically non-existent. Sample plant-population counts taken 26 days after sowing gave the following figures:

Plot.	Average No. of Plants Per Sq. Yard.
1	27.66
2	42.00
3	28.83
4	26.50
5	29.66
6	25.50
7	30.00

It was observed that distribution in the fiddle plots was commendably even, whereas in the hand-sown plots it tended to be "lumpy".

Owing to the necessity for lowering the water-level after sowing, weed-growth was somewhat severe in the early stages but was adequately brought under control by applications of Agroxone 5 per cent. dust at 60 lbs. per acre on the 13th October, 1950, i.e. 30 days after sowing, and at 30 lbs. per acre on the 1st December, i.e. 79 days after sowing.

The growth of the crop was good, the appearance healthy and no losses were sustained from pests or disease.

At harvest, two test plots of 1/10 acre each were cut from each main plot, giving yields as follows:—

	Test Cut A.	Test Cut B.	Av. Per Acre.
Plot.	Lbs. Per Acre.	Lbs. Per Acre.	Lbs.
1	1,341	1,384	1,363
2	1,719	1,579	1,649
3	1,285	1,453	1,369
4	1,876	1,518	1,697
5	1,665	1,604	1,635
6	1,469	1,439	1,454
7	2,161	1,828	1,995

Since only duplicate test cuts were made in each plot the yield figures can only be regarded as indicative of possible differences, but it is interesting to observe that among the tractor-sown plots, fiddle sowing gave appreciably higher yields than hand sowing and that, as was to be expected, the man-sown plots gave better yields than the tractor-sown, although there was little difference between the man-hand plot and the best of the tractor-fiddle plots.

The conclusion drawn from this trial was that direct introduction of padi seed to the land by broadcasting on to a normally prepared surface is a perfectly feasible proposition, and that the most practicable, easiest and cheapest method, if not quite the fastest, is by using a fiddle operated by a man walking through the area to be sown. It has been shown that a man with a fiddle can sow one acre in just over 20 minutes, giving a theoretical coverage of approximately 20 acres per day; in view of the advantage to be gained by the elimination of soil disturbance, it is considered that this method is preferable to a tractor-fiddle combination, even though the latter may be slightly quicker.

It is recommended that, in future, seed used for broadcasting should be germinated for between 24 and 30 hours before sowing in order to allow earlier raising of the water-level after sowing, thereby giving better control over weeds. It has been demonstrated that provided the seed is thoroughly dried off with rock phosphate, there is no difficulty in passing seed which has been germinated for up to 36 hours through the fiddle, and that moreover, no damage appears to be done to the radicles while the seed is passing through the fiddle.

It is also recommended that replicated trials be laid down to determine the seed-rate best suited for optimum population density, weed-suppression and yield.

Note On The Mechanical Spinner.

Before the effectiveness of the man-fiddle combination had been demonstrated, a prototype mechanical spinner was developed for mounting behind a Ferguson tractor.

This consisted of a Jeep generator converted to a motor and driven from the tractor battery; the motor was mounted vertically and a disc, similar in type to that employed in the fiddle, was rivetted to the existing belt-drive pulley. Padi seed was fed on to the disc from a hopper mounted directly above it, and the rate of flow was controlled by a slide within reach of the tractor driver. Control of the motor was by means of a push-pull switch mounted on the tractor dashboard.

This apparatus proved fairly successful in preliminary tests, but, since the speed of the motor could not be varied, it was found that the rate of sowing could not be sufficiently well controlled to give the desired seed-rate. A special motor would have been acquired and further modifications made had not the man-fiddle method proved so effective, and further development on this apparatus was discontinued.

Weed Control.

Weed control may be tackled by land preparation, water control and herbicides.

Where conditions are such that complete control can be exercised over drainage, and when, in addition, a favourable dry spell is experienced, much can be done to suppress weeds before introducing the padi crop; such ideal conditions are, however, rarely experienced and can never be relied upon, but it is possible that repeated, thorough cultivations over a period of years may well change the balance of flora and gradually eliminate entirely certain species.

Water control, again provided that it is *complete* control, can and should play an important part in weed control, and by judicious raising of the water-level in the padi fields, weed growth can, in the case of non- or semi-acquatic species, be to some extent checked.

For controlling weeds which escape cultivation and water control treatments, some method other than hand-weeding must be employed in complete mechanisation if padi is to emerge as the dominant flora.

Previous preliminary trials with a 2,4-D type dust showed considerable promise, but the small engine-driven duster which was made available at the end of the previous season was unfortunately recalled before there was a chance of putting it to a real test, but not before it had been modified for use in a light, two-man carrying frame which promised to be an ideal arrangement.

No other dusting apparatus became available during the period under review, and further investigations could not, therefore, be pursued. Future work should be directed to testing the effectiveness of different selective herbicides, of determining optimum rates of application and of investigating the optimum timing and frequency of applications, both with dusts and low-volume sprays.

Harvesting.

Harvesting is the operation which has so far received less attention than any other and which, therefore, has reached the least advanced stage of development.

Modifications to existing, small, oscillating cutter-bar type grass mowers have not proved successful and have been abandoned.

Reaper-binders have grave disadvantages in the climate of Malaya, which combines high temperatures with high humidity and a propensity to sudden and violent rain storms.

A cereal, trailer-type combine harvester has been quite extensively modified and tested, and has proved moderately successful in harvesting padi, but only where conditions of drainage control and weather have been better than average. In average or worse-than-average conditions it has not been possible to use this combine owing to its cumbersome proportions, excessive weight and lack of manoeuvrability.

It is now generally agreed that a padi harvesting machine for

Malayan conditions must be light, self-propelled and highly manoeuvrable, and that threshing should be done in a small, separate, mobile unit.

General.

It is more than ever abundantly clear that the correct approach to the complete mechanisation of padi growing in Malaya is from the direction of water control.

It is considered that land preparation must, in the majority of cases, be done in wet conditions owing to the unpredictability of the weather, but every endeavour must be made to dry out the land as thoroughly as possible at some time during the year in order to avoid water-logging and the consequent loss of "pan", under which conditions mechanisation becomes impossible. The practice of pre-saturation and irrigation from "the bottom, up" is wholly inimical to the successful introduction of wet padi mechanisation.

Broadcasting of padi on to water also requires complete control of irrigation supplies, and similar control is needed to assist in weed suppression. At harvest time, the greatest possible control over drainage is essential if mechanised harvesting is to be possible.

Finally, it is evident that special strains of padi must be introduced or developed having short, strong straw, an erect, non-lodging habit, a non-shattering grain and even-ripening characteristics, if mechanical harvesting is to be extensively introduced.

Acknowledgement.

Grateful acknowledgement is made of the continued assistance rendered by the mechanisation team at Bukit Merah Padi Experiment Station, ably led by Mr. Thomas David.

References.

(1) Coleman, P.G. "Wet Padi Investigations in Province Wellesley, Season 1949-50." Bull. of Dept. of Agric., Federation of Malaya, Mechanisation Series, No. 1, 1952.

NOTES ON OUTBREAKS, THE PARASITES AND HABITS OF THE COCONUT MOTH *ARTONA CATOXANTHA* HAMPS.

BY

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The dark, olive-brown Zygaenid moth *Artona catoxantha* Hamps. (formerly called *Brachartona*) has no popular name but it is well known locally for the severe outbreaks of its caterpillars which sporadically cause extensive leaf damage in coconut areas.

This insect was apparently first recorded (1) in Malaya in 1904 at Tanjong Kling, Malacca, a locality where thirteen years later the Philippine leaf-beetle *Promecotheca cumingi* Baly was first observed. It was next reported from Batu Gajah, Perak, in 1906 and in Province Wellesley in 1909. Outside Malaya it extends from lower Burma, through Sumatra, Java, Labuan and Borneo as far north as Palawan Island in the southern Philippines.

Outbreaks in Relation to Weather.

The most outstanding facts about the habits of *Artona* are its sudden outbreaks at varying intervals and its dramatically sudden disappearance after reduction by parasites or the commencement of the monsoon. Despite thorough searches from before World War I, to date no local instances of the caterpillars being found in small numbers, i.e. not reaching pest proportions, are yet known, though this is the rule in Java.

In a paper published in 1928 (2), Corbett and Dover gave a list of the months in which *Artona* outbreaks had occurred over seven consecutive years without, however, showing the monthly frequency. Although they omit April as a month with records of attacks, and the senior author four years later confirmed April attacks as being "unusual" (3), yet the accompanying graph and Table I (compiled from 48 outbreaks for 20 years) show that the period from April to June comprises over 40 per cent. of all attacks. It will be seen that there are three times as many outbreaks reported in the drier first six months as compared with the second six months of the year which are wetter. In Java, van der Vecht (4) has shown that a similar annual sequence of maximum and minimum density occurs.

Table II shows the break-down, on a geographical basis, of these 48 outbreaks from 1923-38 and from 1947-52 with the areas under coconuts at intervals of 20 years.

It is interesting to note that although Province Wellesley and Perak lead with the largest number of attacks, yet their areas under

coconuts are now respectively 42,400 and 112,300 acres (the former includes Penang, not shown separately from Province Wellesley in *Malayan Agricultural Statistics, 1949*). In other words, Province Wellesley with about one-third the coconut acreage of Perak is equal to it in reported cases of outbreaks of *Artona*. There is, therefore, no relation between the area under coconuts and the incidence of attacks.

Table I.

Monthly Distribution of *Artona* Outbreaks, 1923 to 1938, and 1947 to 1952.

Month	Outbreaks.	Month	Outbreaks.
January	5	July	5
February	7	August	3
March	4	September	1
April	6	October	2
May	6	November	1
June	8	December	0
Total	36	Total	12

Table II.

Artona Outbreaks by States (1923-38 and 1947-52), and Coconut Acreages.

State or Settlement.	No. of reported attacks.	Area under coconuts. 1930 acres.	Area under coconuts. 1949 acres.
Perlis	—	3,961	3,218
Kedah	—	26,688	31,538
Penang	—	13,526	42,397
Province Wellesley	13	36,821	
Perak	13	115,470 *	112,304
Selangor	9	110,294	101,104
Negri Sembilan	2	5,966	4,768
Malacca	1	12,585	11,165
Kelantan	1	57,271	41,152
Trengganu	1	25,000	20,486
Pahang	4	14,530	13,513
Johore	2	165,050	117,965
Singapore	2	8,000	7,900
Total	48	595,162	507,510

* includes Dindings.

It is reasonable to assume that *Artona* occurs in Perlis and Kedah as the insect is present in southern Burma. The absence of records from Penang and Kedah seems unusual as the latter has 31,500 acres under coconuts. Perhaps the more thorough inspection of large estates enables outbreaks to be noticed more easily than in smaller holdings.

It must be stressed that these records are compiled from attacks considered severe enough either to have been reported to Headquarters or to be recorded in annual reports. Further, they are dependent on the human element as a large number of persons reported the information at first hand and in isolated areas there is naturally less precision in many instances.

Ever since Gater's detailed studies of *Artona* in the middle twenties (5) it has been appreciated that outbreaks usually end with the arrival of high winds and heavy rain at the start of the monsoon; this relationship is very well recognised by the local planting community. The same cause and effect were recorded in the Philippines where an outbreak reported in 1937 in Palawan Island disappeared after heavy rain and wind (7). From records of 48 Malayan outbreaks dating from 1923 to 1938 and from 1947 to 1952 the data examined did not prove sufficiently detailed to show any definite relation between rainfall and the commencement of outbreaks.

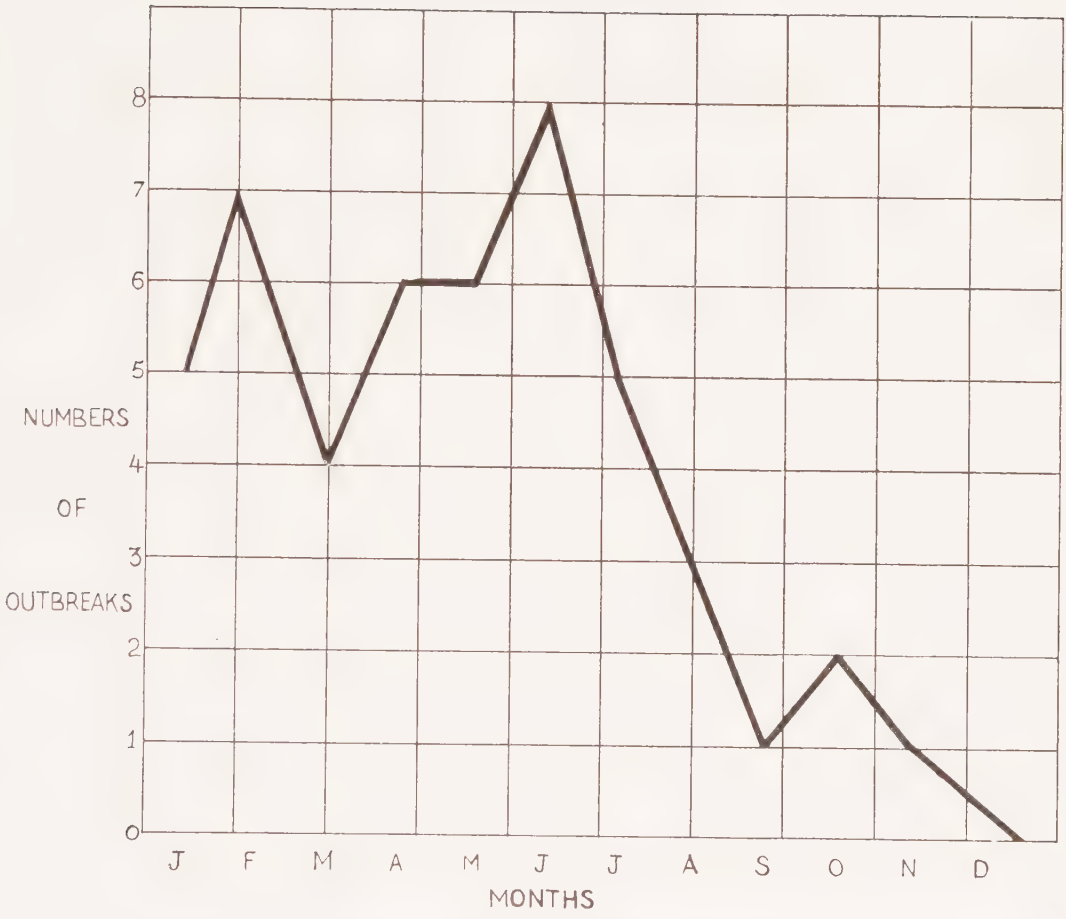
In Java it appears that the effect of rainfall is indirect, and Dr. van der Vecht's suggestion is that when *Artona* is at a low level during periods of prolonged drought, changes occur in the chemical composition of coconut leaves, so reducing the vitality of the insect (4). The underlying relation exerted by certain meteorological conditions upon the parasites, which periodically are reduced below the density needed to check *Artona*, is unknown.

It is, however, recognised that when *Artona* is at a low population level its parasites are also scarce and when the outbreak phase of the former is reached there is a considerable time lag before its parasites catch up and finally reduce the *Artona* caterpillars to a low level.

Insect Parasites.

As a result of Gater's work in 1925 to 1926 (5 and 6), a total of three Dipterous and twelve Hymenopterous parasites was recorded and also one Coleopterous predator. There is also a large number of hyperparasites. Many of these parasites play only a minor role in controlling *Artona* and only the most important will be referred to here.

The Tachinid fly *Ptychomyia remota* Ald., which lays its eggs mainly on the third and fourth instars of the caterpillar, is by far the main controlling parasite throughout outbreaks. It is figured in Departmental Leaflet No. 29, 1951, and can briefly be described as being somewhat like a dark, very bristly house fly with a grey thorax. Full details can be obtained from the Leaflet in question but confusion is possible with the much scarcer fly *Cadurcia leefmansi* Bar., described and figured by Gater (6) as *Degeeria albiceps* Macq. This is a much darker grey,



MONTHLY DISTRIBUTION OF 48 ARTONA OUTBREAKS,
1923 - 38 AND 1947 - 52.

PLATE I

Damage to Coconut Palms by Caterpillars of *Artona catoxantha*.

Kampong Kedah, near Parit Buntar, Perak.
April, 1947.

Nibong Tebal, Province Wellesley.
June, 1952.

(Photographs by R. A. Lever)

especially on the thorax, and slightly larger than *Ptychomyia;* it is merely mentioned here in order to avoid its being regarded as a variety of *Ptychomyia.*

The second important parasite is a small, black-bodied Braconid wasp, *Apanteles artonae* Rohw., which parasitises the second instar larva of *Artona,* i.e. a stage earlier than *Ptychomyia.* It spins an oval, white cocoon beneath the caterpillar which therefore appears to be resting on it. It is interesting to note that in Java *Apanteles* is of greater importance than *Ptychomyia* in controlling *Artona* but in Malaya the former parasite is always much less numerous causing usually only about 5 per cent. parasitism. However, during May and June, 1952, it was found to have been more numerous than usual on some plantations in Province Wellesley.

Gater (5) referred to this *Apanteles* as Braconid No. 1085 with a length of 3 mm. but all specimens seen by the writer reached only 2mm. and this agrees with measurements given in Wilkinson's monograph (8).

The only other primary controlling insect to be mentioned is the predaceous beetle *Callimerus arcufer* Chap. which is easily recognised by having blue wing-cases marked with a white chevron above two white bars. Its larva, which is also predaceous on older larvae and pupae of *Artona* as well as on pupal *Ptychomyia,* is alternately banded white and black with a terminal pair of black forceps and measures overall about one-third of an inch. Its value as a controlling agency is not high compared with the parasites just mentioned and, as stated, it can prove harmful when Tachinid puparia are attacked.

Hyperparasites.

The admittedly complex relationship of the various hyperparasites, i.e. parasites on the parasites of *Artona,* will only be briefly mentioned. Of some interest is a newly recorded Ichneumon taken by the writer in June, 1952, from Province Wellesley. The head, thorax and apical half of the abdomen are jet black, the proximal part of the abdomen being yellowish-brown. This insect is a species of *Microtoridea* and was reared from cocoons of *Apanteles artonae* from which it emerges by means of a ragged hole unlike the terminal hinged lid by which *Apanteles* emerges.*

Another new Malayan determination is the much smaller *Eurytoma albotibialis* Ashm. which behaves either as a parasite of *Artona* or as a parasite of *Apanteles artonae.* It is clear from Gater's description that this small parasite or hyperparasite is identical with his Chalcidoid 1089A and 1089B which are respectively the male and female of *Eurytoma albotibialis* with hairy antennae in the male and smooth ones in the female (5). This insect has not until now been recorded by name from Malaya and in fact is not listed in Dr. W. R. Thompson's "A Catalogue of the Parasites and Predators of Insect Pests" (Part 10, 1950).

Fungus.

Besides the various parasites and predaceous insects mentioned

* Also *Ceraphron* sp. near *fijiensis* Ferr. (Ceraphronid).

earlier, some biological control of *Artona* is frequently exercised by the fungus *Beauveria bassiana* (Bals.) Vuill. whose white spores may give a flour-like appearance to infected larvae. This fungus has been more generally referred to as *Botrytis necans* Massee as it was so named in 1914 from specimens taken the previous year at Bukit Sembawang, Singapore. However, the name *Beauveria* was used as long ago as 1853 so that Massee's name is invalid; this fungus has a wide distribution and occurs in England. Attempts were made in 1914 to spread fungal infestation by placing fronds from Serangoon bearing infested caterpillars of *Artona* on palms at Ponggul and Geylang. These palms were attacked by *Artona* which was free from the fungi but the outbreak ended suddenly in February 1914 (9). In the same year the fungus was sent to Fiji in an attempt to control a closely allied pest (10), which was in fact controlled eleven years later by *Ptychomyia* from Malaya.

A similar attempt was made to check an *Artona* outbreak in 1921 at Menglembu, Perak, with fungal-infected caterpillars sent on fronds from Province Wellesley and pinned onto palms to spread the fungus (11). This method was said to be the best means of encouraging the fungus and thus controlling *Artona*.

On various occasions since then sporadic *Artona* outbreaks have been reported as being checked by *Beauveria*. This fungus was found on caterpillars near Nibong Tebal, Province Wellesley, in June, 1952. The writer is indebted to the Acting Senior Plant Pathologist for kindly having the identity of this fungus checked at the Commonwealth Institute of Mycology, Kew. The fungus was collected by the writer on caterpillars in this particular coconut plantation.

It is usually agreed today that these fungi will only develop widely in wet weather, hence artificial attempts to inoculate caterpillars will not result in increasing fungal attack compared with the natural spread during suitable weather conditions.

Birds.

One interesting record which appears to be unique is quoted here in case it occurs again; a light outbreak six miles northwards from Kuala Selangor in 1922 was controlled by crows and by heavy rain (13). Unfortunately the species was not given but the common gagak or southern large-billed crow (*Corvus m.macrorhynchos*) seems to be the most likely bird. The Ceylon house crow (*Corvus splendens protegatus* Madar), introduced at Klang in 1902 to deal with a coffee pest, does not even now apparently occur so far north and it almost certainly had not extended to Kuala Selangor thirty years ago.

Host Plants and Feeding Habits.

A few general points of interest about *Artona* are given in this section, commencing with alternative food plants of the larva.

Gater listed leaves of betel nut (*Areca catechu*) as being eaten in Malaya but not in Labuan, which island he visited in 1924 (5). In

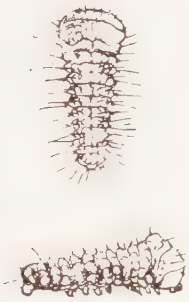


FIG. 1

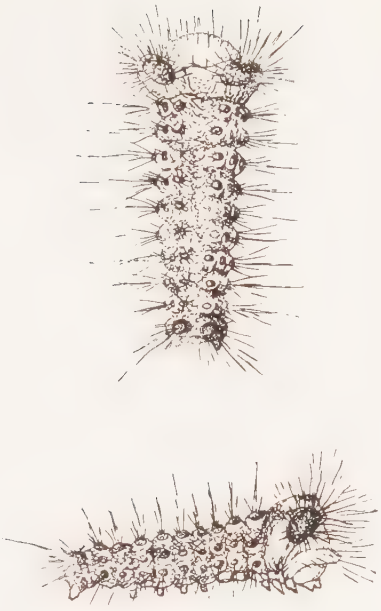


FIG. 2

FIG. 3

LARVA OF ARTONA CATOXANTHA.

Fig. 1. First instar · 20.
Fig. 2. Second instar × 20.
Fig. 3. Third instar × 20.

(*Malayan Agric. J.*, **14**, 304) (B.A.R. Gater, 1926.)

a very detailed study of this insect in Java, van der Vecht found *Artona* larvae refused to eat leaves of this palm (12) and this was confirmed by the writer in Malaya in tests where the larvae refused this diet for three days and were moribund until switched to coconut which they eat readily. In the Krian outbreak of April, 1947, it was noticed that while leaves of nipah near the attacked coconuts showed damage by *Artona*, adjacent betel nut palms were untouched. However, the Senior Entomologist (Mr. H. T. Pagden) has seen an instance of damage by this caterpillar to *Areca* so this palm must be considered as being eaten as a last resort despite what invariably happens in Java and usually in Malaya.

Except for banana, also a very unattractive host plant, all the records for Malaya are of palms; fortunately the oil palm has not been attacked here though it is abnormally so in Java in the absence of more usual host plants (12).

A somewhat unusual habit was reported by van der Vecht in the last-mentioned paper which, though published in 1950 was in the press in 1941, the delay being due to the Pacific War. This habit had been noted by the writer during an outbreak at Krian in April, 1947, or three years before van der Vecht's paper was published. It consists of the sudden expulsion of the droppings which are shot singly to a considerable distance by the sudden muscular contraction and relaxation of the anal segment. This is raised up from the leaf surface immediately prior to the discharge of the pellets which are composed of somewhat coarse leaf-fragments.

Recognition of the earliest stage of the larva—the first instar—is apt to be overlooked owing to its very small size. Four or five days after being laid the egg hatches into a translucent, yellowish-white caterpillar measuring 1 mm. or one-twenty-fifth part of an inch in length. The feeding during this first instar, which lasts only for four days, consists of small, circular pits in the leaf surface quite unlike the parallel scars made later. Even by the second instar the larva measures only 2.5 mm. and what are reported or referred to as first or second instars are in reality very often the third, measuring 4 to 5 mm. in length. (Fig. 1 to 3).

It is worth recalling that Pratt as early as 1909 (14) recommended the use of binoculars to detect the first broods or generations (not the first instar) of *Artona* and this advice could well be followed, especially between April and June.

Non-Biological Control.

As a matter of interest the various prewar methods of artificial control are listed below. However, it so happens that the unusual nature of the successive generations of *Artona* caterpillars in relation to their parasites results in only a limited use of the newer insecticides. Their very high toxicity causes a higher mortality to the parasites than to the pest and reliance on these natural enemies is still held to be the best method for checking *Artona* outbreaks.

The very first control recommended was kerosene emulsion spraying combined with cutting off and burning the tips of the lower leaves and catching the moths with hand nets (14). This last method was still recommended in 1920. Light traps and sweet poison baits had been found ineffective in the same year (15).

Removal of the entire lower leaves was suggested in 1914 (9), while in 1925 (5) jets of water from fire hoses were used, four acres of palms being sprayed per day. It was considered that a small power pump would be more practical but was not actually recommended for estate use.

Up to 1950 cutting out of leaves or spraying or dusting with lead arsenate in the early stages were the standard methods, often accompanied by grease banding of the trunk with rosin and castor oil. Caterpillars blown down by the wind are caught on these bands when climbing up the palm trunks into the crown.

In an extensive attack, starting in April, 1950, on a coconut estate in Krian, DDT was used in October at the rate of 1½ gallons per acre of 12% DDT in diesel oil applied as a fog. This, however, entails the use of a fog generator which is too expensive to purchase for all but the largest estates. As shown in Agricultural Leaflet No. 29, it is sometimes permissible to spray with either 50% DDT (2 lbs. in 100 gallons of water) or 6.5% gamma ("Gammexane") BHC wettable powder at the rate of 4 lbs. per 100 gallons.

However, this is only to be done when the outbreak is confined to such a small area that it can be so thoroughly sprayed as to ensure a complete cover, and this entails power-operated machinery. Otherwise, it is best to allow parasites and stormy weather to take control of the outbreak particularly if the caterpillars have already reached the third instar, recognised by the dark central stripe along the dorsal surface of the body which measures approximately one-fifth of an inch in length.

One can summarise by saying that as a result of many years experience of outbreak records it is recommended that the pre-war practice of allowing the parasite to catch up with the pest still holds good today. Despite the availablity of such potent insecticides as DDT or BHC ("Gammexane") the inevitability of their killing the more delicate parasites will offset the control exercised by these insecticides.

The writer is obliged to the Acting Chief Research Officer (Mr. R. B. Jagoe) and the Senior Entomologist (Mr. H. T. Pagden) for constructive criticism during the preparation of this paper.

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THE CONTROL BY SPRAYING OF SOME DISEASES OF HIGHLAND VEGETABLES

BY

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Introduction.

The climate at Cameron Highlands and in neighbouring areas (altitude 3,000—5,000 ft.) is well suited to the growing of many temperate vegetables. Unfortunately during most of the year conditions are also very favourable to the development of fungus diseases. The temperature is more or less constant throughout the year and there is no pronounced dry period so that the growth of the fungi can continue unchecked; in addition, the frequently high humidity aids their rapid spread by providing conditions suitable for spore germination and infection of the host plant. The result is that many vegetable crops are severely damaged by disease.

This paper deals with experiments carried out on four diseases of different crops. The diseases chosen for experiment were potato blight, carrot leaf blight, celery leaf spot and French bean anthracnose, all of which commonly occur at Cameron Highlands and are liable to cause serious damage. Little information concerning the control of these diseases under local conditions was available; the experiments were therefore designed to discover firstly whether spraying with copper fungicides would give control, and secondly whether control of the diseases would result in increased yields.

The experiments were carried out at the Federal Experiment Station, Tanah Rata, during 1951 and the beginning of 1952.

Potato Blight.

This is the most serious disease of potatoes at Cameron Highlands, and unless spraying is carried out the crop is almost certain to fail or to yield only poorly. The cause of the disease is the fungus *Phytophthora infestans* (Mont.) de Bary, which attacks the leaves causing black, rotten areas to develop (Plate 1). These, especially in wet weather or when there is a heavy dew, spread rapidly, soon killing the whole leaf. As the disease progresses the stem is also killed.

As it was known from past experience that control could be obtained by spraying with a copper fungicide a preliminary experiment to demonstrate this was not carried out. Nor was it considered necessary to include unsprayed plots in the experiments described below as it had been found previously that unless the plants were sprayed the crop was likely to be lost.

Two experiments were carried out, the first to compare the control obtained with three copper fungicides, the second to discover whether the spraying interval could be lengthened beyond a week without giving rise to an adverse effect on yield. The variety used was a very susceptible one of unknown name, locally obtained. In both experiments spray was applied at an average rate of 90 gallons per acre at each application.

In the first test the sprays used were Perenox (0.5 per cent.), Shell Copper Fungicide (0.5 per cent.) and Bordeaux mixture (4:5:40). Spraying began 3½ weeks after planting and continued at weekly intervals until harvest. None of the treatments gave completely adequate control, considerable infection taking place towards the end of the experiment. No difference in the degree of infection in the different treatments was detected. Yields are given in Table I.

Table I.
Potato Blight.
Test of Three Copper Fungicides.

Treatment.	Mean yield per plot.	Equivalent yield per acre.
	ozs.	lbs.
Perenox	297	13,365
Bordeaux mixture	281	12,645
Shell Copper Fungicide	243	10,935

* S.E. = 28.
† M.S.D. (5 per cent.) = 62.
Layout: ×6 randomised block.

Differences between the mean yields obtained with the three treatments were not significant at the 5 per cent. level; it thus appears from this experiment that the three copper fungicides are equally efficient in controlling blight.

In the second experiment, in which Perenox was the fungicide used, three spraying intervals were compared—7 days, 10 days and 14 days. Spraying was begun four weeks after planting and continued until harvest. Completely satisfactory control was not obtained, even with the shortest spraying interval, but it was noticeable that the foliage in the plots sprayed at weekly intervals remained green for considerably longer than that in the plots sprayed at the longer intervals. Yields are shown in Table II.

At the 5 per cent. level the mean yield of the plots sprayed at intervals of seven days was significantly greater than that of the plots sprayed at intervals of either 10 or 14 days. The difference in yield between the two latter treatments was not statistically significant.

* S.E. = Standard Error.
† M.S.D. = Minimum Significant Difference.

Table II.
Potato Blight.
Test of Different Spraying Intervals.

Spraying interval.	Mean yield per plot.	Equivalent yield per acre.
	ozs.	lbs.
7 days.	267	12,015
10 days.	217	9,765
14 days.	198	8,910

S.E. = 17.
M.S.D. (5 per cent.) = 38.
Layout: ×6 randomised block.

Discussion.

Good control was not achieved even with weekly sprayings, and increasing the spraying interval to 10 and 14 days resulted in a decrease of crop of 18.7 and 25.8 per cent. respectively. Despite the incomplete control, application of Perenox, Bordeaux mixture, and Shell Copper Fungicide made it possible to obtain a reasonable crop. The present recommendation is that spraying should be done weekly, using one of these three fungicides at the concentration used in these experiments.

Carrot Leaf Blight.

This is a leaf disease caused by the fungus *Alternaria dauci* (Kuhn) Groves and Skolko. Numerous small spots are formed on all parts of the foliage; these rapidly enlarge and in a short time the whole leaf is killed. If attack begins early, as it may if consecutive crops overlap or are planted at short intervals, the plants may be killed off completely. More usually the disease appears later; then all the leaves except one or two of the youngest may be killed, so that the plants are bereft of the greater part of their foliage (Plate II) but some crop is obtained.

Spraying Experiments.

The variety used in these experiments was Manchester Table. To discover if adequate control could be achieved by spraying, an unreplicated trial of three plots was first carried out. One plot was left unsprayed while the other two were treated with Perenox (0.5 per cent.) and Bordeaux mixture (4:5:40) respectively. The plots were sprayed at weekly intervals, commencing six weeks after planting (when the first signs of disease appeared) and continuing until harvest. To compare the infection in the three plots the plants were divided into four arbitrary classes:

0 — no infection
1 — small spots on leaves
2 — some leaves with large dead areas
3 — some leaves killed

The percentage of plants in each category is shown in Table III.

PLATE I

Potato Blight (*Phytophthora infestans*).

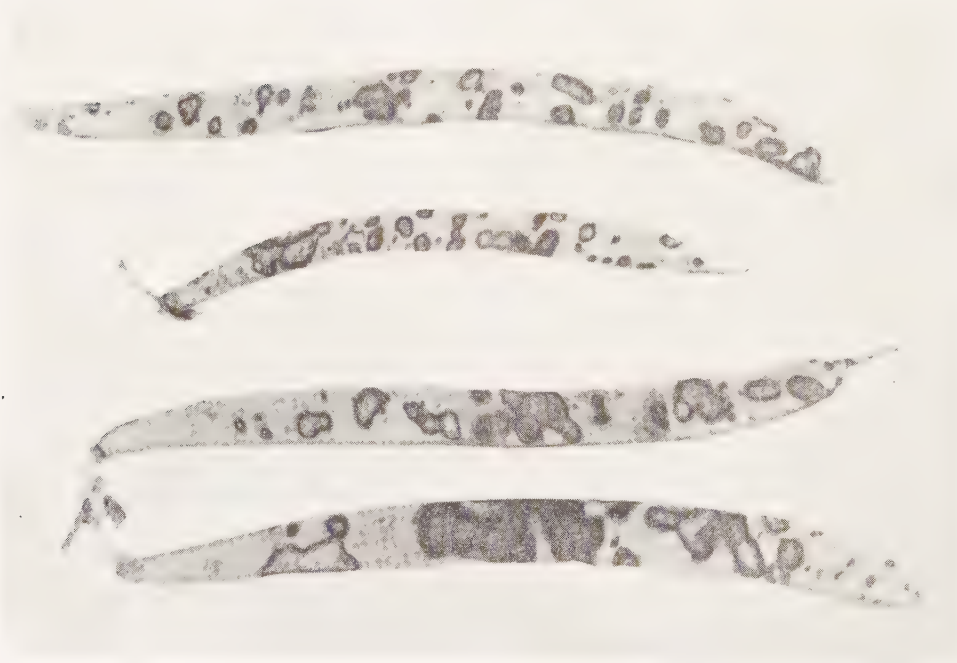
PLATE II

Carrot Leaf Blight (*Alternaria dauci*).

PLATE III

Celery Leaf Spot (*Septoria apii-graveolentis*).

PLATE IV



French Bean Anthracnose (*Colletotrichum lindemuthianum*).

Table III.

Carrot Leaf Blight.

Infection Before Harvest.

(per cent.)

Treatment.	Degree of Infection.			
	0	1	2	3
Perenox	80	18	1	1
Bordeaux mixture	81	16	2	1
No spray	1	15	42	42

Few of the sprayed plants had more than mild infection whereas most of the unsprayed plants were heavily attacked.

A second experiment was laid down to discover whether leaf blight depresses yield. The trial consisted of two treatments—spraying with Perenox (0.25 per cent.) and not spraying. Spraying, at an average rate of 140 gallons per acre, was started eight weeks after planting and continued at weekly intervals until harvest. By then many of the leaves of the unsprayed plants were black and dead, whereas sprayed plants remained green and healthy. Yields are given in Table IV.

Table IV.

Carrot Leaf Blight.

Spraying With Perenox.

Treatment.	Mean yield per plot.	Equivalent yield per acre.
	ozs.	lbs.
Perenox	288	20,366
No spray	207	14,638

S.E. = 25.
M.S.D. (5 per cent.) = 58.
Layout: ×9 randomised block.

The increase in yield of the sprayed plots, amounting to 39.1 per cent. of the yield of the unsprayed plots, is significant at the 5 per cent. level.

DISCUSSION.

In these experiments, infection did not develop quickly and severe leaf damage only occurred at a fairly late stage in the growth of the carrots. Despite this, spraying gave a substantial increase in yield in the second trial and it is to be expected that with earlier infection the

benefit of spraying would be even more marked. The strength of spray in the second experiment was only half that in the first but gave good control. Spraying at weekly intervals with 0.25 per cent. Perenox is recommended.

Celery Leaf Spot.

This disease is caused by the fungus *Septoria apii-graveolentis* Dorogin, which causes small, roughly circular spots on the leaves (Plate III). These may be very numerous, in which case the whole leaf shrivels and dies prematurely. The outer leaves are attacked first, but in severe cases, such as occur frequently at Cameron Highlands, the young leaves also are attacked and the plant is stunted and sometimes killed. The disease is probably always present on crops of celery and usually causes considerable damage.

SPRAYING EXPERIMENTS.

A preliminary, unreplicated experiment using Perenox (0.5 per cent.) and Bordeaux mixture (4:5:40), applied at weekly intervals showed that at least partial control could be obtained. Results are shown in Table V, where the figures indicate the percentage of plants exhibiting the varying degrees of infection, these being assessed in the same way as in the first carrot trial.

Table V.
Celery Leaf Spot.
Infection Before Harvest.
(per cent.)

Treatment.	Degree of Infection.			
	0	1	2	3
Bordeaux mixture	2	66	22	10
Perenox	0	60	36	4
No spray	0	0	4	96

On the majority of the unsprayed plants several leaves were killed completely, but most of the sprayed plants showed only mild leaf-spotting.

A second experiment was laid down to find out whether spraying would give an increased yield and also whether the spraying interval could safely be extended beyond seven days. Three spraying treatments were tested, using Perenox (0.25 per cent.) applied at intervals of 7, 10 and 14 days. In addition, unsprayed plots were incorporated. Spraying, at an average rate of 67 gallons per acre, was begun three weeks after planting out and continued until harvest.

Infection was severe, even the weekly sprayed plots showing numerous leaf-spots, and yields were poor. As shown in Table VI, however, considerable differences in yield were recorded.

Table VI.
Celery Leaf Spot.
Test of Different Spraying Intervals.

Spraying interval.	Mean yield per plot.	Equivalent yield per acre.
	ozs.	lbs.
7 days	132	5,940
10 days	100	4,500
14 days	70	3,150
No spray	64	2,880

S.E. = 13.
M.S.D. = 28.
Layout: ×6 randomised block.

Plots sprayed at intervals of 7 and 10 days gave significantly increased yields over the unsprayed plots but spraying at intervals of 14 days gave no significant increase. Spraying at intervals of seven days, which gave an increase in crop over the control of 106 per cent., was more effective than spraying at intervals of 10 days. Even the latter, however, gave an increase in yield over the control of 56 per cent.

Discussion.

As in the case of potato blight, weekly spraying was very much more beneficial than 10-day spraying, the extra three sprayings (11 in the weekly treatment as compared with eight in the 10-day treatment) giving an increase in yield of 32 per cent. The standard of control in the second experiment was not so high as in the first; it would therefore be advisable to use the higher concentration of fungicide used in the first experiment.

French Bean Anthracnose.

This disease is caused by the fungus *Colletotrichum lindemuthianum* (Sacc. & Magn.) Br. & Cav. It usually appears first on the leaves, where elongated, angular, red-brown spots are formed along the veins; but most damage is caused by the later attack on the pods. On these, circular, red-brown, sunken areas develop. These later turn dark-brown or black and often bear pink pustules of the spores of the causal fungus. The spots are frequently numerous and if attack occurs early the pods wilt and die; at a later stage the pods grow normally but are so disfigured as to be rendered useless (Plate IV).

Spraying Experiments.

The first experiment was a small, unreplicated trial of three plots, carried out to discover if control could be obtained with copper fungicides.

These were represented by Bordeaux mixture (4:5:40) and Perenox (0.5 per cent.). An unsprayed plot was included for comparison. Spraying was begun five weeks after planting, when the first symptoms of attack appeared on the leaves, and continued at weekly intervals until all the crop had been harvested.

As judged by the number of pods infected, good control was obtained. In the unsprayed plot the percentage of infected pods was 24.6, compared with 2.8 in the plot sprayed with Perenox and 0.9 in the plot sprayed with Bordeaux mixture.

A second experiment was laid down to confirm these results and to discover if the yield of marketable beans was significantly increased by spraying. Four treatments were incorporated—no spray and spraying with Perenox (0.25 per cent.), Shell Copper Fungicide (0.25 per cent.) and Bordeaux mixture (2:2.5:40). The variety of French bean used was Hawaiian Wonder. Spraying, at an average rate of 220 gallons per acre, was begun six weeks after planting and continued at weekly intervals until the end of harvest. Results of this experiment are summarised in Table VII.

Table VII.
French Bean Anthracnose.
Test of Three Copper Fungicides.

Treatment.	Percentage of healthy beans.
Perenox	79.4
Bordeaux mixture	74.8
Shell Copper Fungicide	68.6
No spray	46.0

S.E. = 3.8
M.S.D. (5 per cent.) = 8.1
Layout: ×6 randomised block.

At the 5 per cent. level all spray treatments gave a significant increase in percentage of healthy beans over the no spray treatment. The percentage of healthy beans given by spraying with Perenox was significantly larger than that given by spraying with Shell Copper Fungicide.

Discussion.

That spraying with a copper fungicide will increase the proportion of healthy pods is shown by the second experiment, but even in the most successful treatment over 20 per cent. of the pods were attacked. More complete control is desirable and might be obtained by using a more concentrated fungicide or by spraying at shorter intervals. For the present it is suggested that spraying should be carried out at weekly or

shorter intervals using 0.5 per cent. Perenox or a similar strength of another copper fungicide.

Spraying also controlled two leaf diseases besides anthracnose. Powdery mildew, caused by a species of *Oidium*, was almost completely suppressed, and target spot, caused by *Ascochyta phascolorum* Sacc., was much reduced in severity.

Conclusions.

Except in the case of potato blight, no information was available concerning the efficacy of spraying against vegetable diseases under local conditions. The experiments described above were therefore only of an exploratory nature; they do, however, indicate that spraying is effective both in controlling certain diseases and in giving increased yields.

Although sufficient information has not yet been obtained for it to be possible to give final recommendations regarding optimum spraying interval and concentration of fungicide, suggestions have been made for each disease. From these it will be seen that satisfactory results can generally be obtained by spraying at weekly intervals with 0.5 per cent. Perenox or Shell Copper Fungicide. Bordeaux mixture (4:5:40) is equally effective but is more troublesome to prepare and apply. Only three fungicides were used in these experiments but it is likely that other copper fungicides, applied at equivalent concentration, would give comparable results.

Summary.

Experiments to control four diseases of highland vegetables with copper fungicides are described. The diseases investigated were potato blight, carrot leaf blight, celery leaf spot and French bean anthracnose.

In all cases spraying resulted in increased yields.

The interval between sprayings should not be longer than one week. 0.5 per cent. Perenox or an equivalent concentration of some other copper fungicide gives good results.

NOTES ON CURRENT INVESTIGATIONS, OCTOBER TO DECEMBER, 1952.

Compiled by the Acting Chief Research Officer and the Senior Agronomist.

Padi.

1. RESEARCH.

Variety Trials and Selection.

With the completion of transplanting at padi stations in the Kuala Selangor area, all trials have been established in the field. Most trials are in the tillering stage and are proceeding satisfactorily. Harvest has commenced at Ulu Klawang in Negri Sembilan.

Extension Trials.

In addition to trials mentioned in the last report, a fourth trial is being carried out at 128 sites in Malacca using Reyong 6 in the coastal areas and a new selection, Serendah Kuning 5003, in inland districts.

Hybridisation.

Plants of the four *indica* x *japonica* hybrids grown at Kuala Lumpur matured in 90 to 130 days and yielded well. Those planted at Pulau Gadong have grown less vigorously; they are now ripening and have produced some promising segregants.

Investigations with different hybridisation methods have shown that the thermos flask technique is the most satisfactory one for Malayan conditions.

Disease Control.

An attempt is being made to record disease symptoms grouped under the name " penyakit merah " to clarify the position as regards this rather obscure condition. So far specimens have been received from Kelantan and Kedah and a few from other areas. The commonest symptoms observed have been premature yellowing and dying of the outer leaves, stunting of the plants and extensive rotting of the root system, which is often poorly developed. These symptoms are characteristic of potash deficiency, but small trials laid down in Kedah have failed to confirm that application of potash has any effect on the disease.

In connection with "penyakit merah" studies, padi plants are being grown in nutrient solutions to observe the effect on growth of deficiency of the major elements.

2. AGRONOMIC INVESTIGATIONS.

Wet Padi.

In a nursery manurial trial on sandy soil at Bachok, Kelantan, it is reported that large differences in vigour have resulted from experimental treatments. Elsewhere, however, visible differences between

manured and unmanured seedlings have failed to persist for any length of time after transplanting in the field.

At Bruas, in Perak, experiments have once again been subject to persistent attacks by the black padi bug, *Scotinophara coarctata*, which has been a serious pest in that region ever since the Japanese occupation of Malaya.

From Kedah it is reported that the introduced legume *Aeschynomene americana* has shown considerable promise as a green manure crop for wet padi land.

The very important series of 100 *bendang* manurial experiments on smallholdings in Kedah and Province Wellesley is reported to be progressing according to plan and two trials have already been harvested in Kedah.

Dry Padi.

In the so called "deficiency area" at Tanah Merah, Kelantan, crop growth in the 1951-52 season showed a marked response to nitrogen, phosphorus, potassium and lime. There is still no evidence of any marked minor element deficiency.

In the current season growth generally has been satisfactory and most experiments are proceeding according to plan. In some trials, however, irregular growth as a result of uneven nitrogen application is likely to mask other differences.

Cacao.

1. Research.

State and Settlement Amelonado Seed Gardens.

Distribution of planting material during the quarter for the establishment of seed gardens totalled 1,111 cuttings, 300 seedlings and budwood for about 900 buddings. Twenty-three pods were harvested from the Amelonado seed garden of which 19 were distributed. Seed from the reminder was germinated at Serdang. Stocks of hardened cuttings and seedlings at the end of the quarter totalled 1,955.

Introductions.

Thirty-nine Upper Amazon type seedlings were planted out in October, and 40 *Herrania* seedlings previously planted are doing well. Of 35 imported I.C.S. clonal cuttings only 11, representing seven clones, have survived.

Vegetative Propagation.

An experiment to compare various methods of treating cacao cuttings with rooting hormones has been started. Two "quick dip" treatments are being compared with Seradix B No. 3.

Pest Control.

Damage to the trunks of cacao trees, resembling that described as caused by caterpillars of the Hepialid moth *Phassus damor* Moore was

reported from an estate in Perak. Two larvae were obtained from samples submitted, but they cannot be identified with certainty until the moth has been bred.

An unusual form of leaf damage in which sections of the veins were caten out was found in Trengganu and was traced to the Lamiid beetle *Glenea funerula* Thoms. Shoot damage to Trinitario, caused by the larvae of a species of *Alcidodes* (Curculionidae), was also found in Trengganu.

Helopeltis theobromae Miller on cacao at Benta, Pahang, has been greatly reduced by spraying with wettable DDT (50% DDT) at ½ lb. in 25 gallons (0.1 per cent. active ingredient).

Damage to roots of cacao caused by grubs of a chafer beetle *Leucopholis* sp. was reported from Gajah Mati, Kedah.

Disease Control.

A hitherto unrecorded leaf disease has been observed at the Federal Experiment Station, Serdang, where it is now of common occurrence. Numerous small, irregular, brown spots are formed on young leaves which, when attack is heavy, may be distorted. A species of the fungus *Gloeosporium* occurs in association and when inoculated on to healthy leaves the disease was reproduced. At present attack does not appear to be serious enough to warrant control measures.

A further case of purple stem rot, first recorded in the last quarterly report, has been observed, again in association with *Nectria* sp.

An investigation of the effect on cherelle wilt of spraying with hormones (p-chlorophenoxyacetic acid and alpha-napthaleneacetic acid) and Bordeaux mixture has been commenced.

An experiment to compare Fermate and Zerlate as fungicides to control basal rot of cacao cuttings has been started.

Certain cacao buddings on basketted stocks were chlorotic and many died. Leaf tip injection with 1% ferrous sulphate established that iron deficiency was the cause of the chlorosis. Spraying weekly with 1% ferrous sulphate has greatly improved the condition of the surviving buddings.

2. Agronomic Investigations.

Seed nurseries of West African Amelonado cacao have shown very satisfactory uniform growth under jungle shade in Trengganu, and this variety is now doing well at Serdang, Selangor, under both jungle and cultivated shade.

Good, early growth of Trinitario cacao has been shown by one-year old plants intercultivated with young rubber on Malacca Series lateritic soils on an estate in Negri Sembilan. Experience elsewhere suggests that, on this soil type, root competition from hedge-row rubber is much less than on more fertile soils. However, both crops will require regular manuring.

In trials on estates and agricultural stations throughout the

country it is now clear that the major pests are likely to be the sucking bug *Helopeltis* and mammals such as squirrels, tree-shews and monkeys.

Oil Palm.

1. Research.

Two selection trials covering 50 acres of pedigree dumpy progenies have been planted, and 110 acres of observation plots of dumpy progenies have been planted on two estates.

A further 4,280 seeds and 622 seedlings of dumpy strains have been distributed.

Assisted pollination of dumpy palms has resulted in a small but significant increase in the clean fruit on bunch percentage. The experiment is still in progress.

Oil Palm at Various pH Levels.

In the pot experiments, palms growing in the soil treated with lime at the rate of 10 tons per acre (pH 7.0-8.0) were still growing better than in untreated soil (pH 4.5-5.0) or soil treated with 20 tons per acre (pH 9.0-9.7). Further leaf analyses confirm the results reported in the previous quarter.

Pest Control.

The small reddish-brown ant, *Pheidologeton nanus* Roger, was responsible for serious losses of oil palm seedlings on an estate in North Perak. The ant hollows out the oil palm seed and the stem of the young seedling, causing its death. The application of a BHC dust or a BHC dispersible powder to the soil round the palms was highly successful.

2. Agronomic Investigations.

In 1950, a co-operative cultivation experiment was laid down on a Selangor estate on coastal alluvium in which the main treatments depended on the mechanical construction of internal drains and arched beds. Unfortunately the heavy track-tractors used damaged the soil structure of the heavy clay and planting has still not been possible. The land is now to be used for padi cultivation.

An important trial of tall oil palm varieties was planted out at the Federal Experiment Station, Jerangau, Trengganu, in early November and no casualties have been reported. On this undulating granite soil a planting distance of 32 x 32 ft. triangular has been adopted and the whole trial, with perimeter discards, occupies 11 acres.

Coconut.

Research.

Pest Control.

The outbreak of *Artona catoxantha* Hamps. mentioned in the last report had almost died out by October.

Fibres.

1. RESEARCH.

Ramie.

The quality of the first batch of fibre extracted mechanically from selected clones under trial has fallen short of commercial standards.

Jute.

A stem canker of jute, growing at the Federal Experiment Station, Kuala Lumpur, was found to be caused by a species of *Colletotrichum* of the *C. capsici* group. Cankers appear on all parts of the stem. Just above soil level the disease causes deep injuries which cause the death of the plant. The same fungus has also been found causing damping off of seedlings. It appears to be seed-borne.

2. AGRONOMIC INVESTIGATIONS.

In a jute variety trial which was harvested last quarter on Sungei Burong Agricultural Station, Selangor, the Segama variety of *C. capsularis* gave a yield of fibre of 814 lbs. per acre, the fresh stems yielding 5.75 per cent. dry fibre. The other four varieties under test gave very low yields of short stems. In this particular trial the stand was somewhat thin and it is probable that a heavier seed rate will lead to higher yields of Segama. Fibre quality of this variety would appear to be good.

A Manila hemp variety trial was planted at Sg. Burong Agricultural Station in November as experience elsewhere has shown that this crop thrives on muck soil.

In a co-operative experiment on an estate in north Johore where Manila hemp was interplanted with young rubber in May, 1951, establishment of both crops has been good but growth of the hemp has been disappointing although uniform. The soil is a sandy loam, and clean weeding, mulching and manuring have been recommended.

Tea.

RESEARCH.

Selection.

Rooting trials of selected clones at Cameron Highlands have not proceeded satisfactorily. The last batch of cuttings, however, has done considerably better than the first two batches. An improved rooting technique is being sought.

The experiment to increase the copper content of tea leaf by spraying the area around the bushes with a weak copper sulphate solution was continued. After the last spraying on the 2nd September, the copper content of the leaf rose during the period of the next three pluckings and then started to come down.

Disease Control.

Reports indicate that blister blight (*Exobasidium vexans*) attack has not so far been severe at Cameron Highlands this season.

An experiment has been laid down on an estate at Cameron Highlands, in which attack by the disease is heavy, to discover whether under these conditions the protection afforded by spraying increased yield.

Pineapple.

1. Research.

Selection.

Survey of variation in fruit characters at canneries and plantations in Johore and Selangor was started in December and will be continued during the "small" season.

Consignments of Smooth Cayenne suckers, 1,470 from Australia and 50 from South Africa have been received and planted in quarantine.

Selection stocks planted at the Federal Experiment Station, Jalan Kebun, are growing well and showing large variations in growth and plant habit.

Pest Control.

Tests with two formulations of Schradan and with Hanane against the pineapple mealy-bug gave negative results.

Disease Control.

One of a number of isolations of bacteria from plants affected by heart rot reproduced the disease in plants injured by pricking. Inoculations show that the disease develops very rapidly, first symptoms appearing within 18 hours of inoculation and the disease being in an advanced stage two to three days afterwards. Investigation of the bacteria causing this disease is continuing.

A trial was laid down to discover whether the incidence of broken core disease is affected by the local practice of decrowning fruits during growth. Incidence of broken core in normal fruits was 6.25 per cent. compared with 17.5 per cent. in fruits whose crowns were removed.

A bacterial soft rot of suckers occurring within six weeks after planting out was investigated at the Federal Experiment Station, Jalan Kebun. It was concluded that the trouble could be avoided by ensuring that planting material was not trimmed too drastically and was thoroughly dried before planting out.

2. Agronomic Investigations.

Five manurial experiments have been laid down during the quarter on the new Federal Experiment Station, Jalan Kebun, and subsequent growth has been satisfactory. Many of these trials are being interculti-vated mechanically, using an M.G.5 track-tractor and a locally made disc-harrow.

In co-operative trials on Johore plantations theft of fruits is interfering with the progress of hormone-spraying trials. Observations on manurial trials in the same area indicate that adequate potash and nutrient sprays of copper are necessary for healthy growth.

Pasture and Fodders.

RESEARCH.

Axonopus spp. and Shade.

Recent protein analyses confirm those previously reported, and in addition show a higher carbohydrate content in samples from the unshaded treatments.

Vegetables and Food Crops.

1. RESEARCH.

Tomato.

Experiments on control of bacterial wilt (*Xanthomonas solanacearum*) of tomato have shown that one treatment with DD soil fumigant is ineffective, but two treatments, separated by the growing of one non-susceptible crop, give fairly good control.

Onion.

The onion leaf-miner *Dizygomyza cepae* Hering continues to give trouble in Singapore. It is believed to be confined to a small area only and a survey is to be undertaken with a view to its eradication.

Selection.

Selection for yield of soya beans and sweet potato for tops has been continued, and selection of groundnuts has been resumed.

2. AGRONOMIC INVESTIGATIONS.

A fresh series of vegetable manurial experiments have been laid down at the Federal Experiment Station, Cameron Highlands, in an attempt to devise a satisfactory system of cultivation which is not associated with fly breeding.

A potato variety trial using twice-grown Dutch "seed" has given the very satisfactory mean yield of 15,358 lbs. per acre, with the best variety yielding 24,654 lbs. per acre. Careful storage of seed tubers is necessary in a dry, dark room. Sprouting is retarded by spraying with 0.25 per cent. alpha-naphthaleneacetic acid.

Two sweet potato variety trials carried out at the Federal Experiment Stations, Serdang and Kuala Lumpur, have shown that the heaviest yields of tubers are given by the varieties Hoey Tong, Ampat Bulan, Eu Tin and Kang Kong 58. The poor quality of Hoey Tong and the low dry matter content of its tubers make it suitable only for stock food. The other three varieties have a dry matter content ranging from 25.17 to 31.01 per cent. and they are all of good eating quality.

Fruit.

1. RESEARCH.

Banana Pests.

Bananas in a very stunted and backward condition, in some cases dying, examined in Selangor, were found to be infested with eelworms

said to be *Radopholus similis*. This eelworm commonly causes serious damage to pepper in Banka and Borneo. Samples have been submitted to the United Kingdom for determination.

Rambutans at the Agricultural Station, Tanjong Malim, have been attacked by a gall-forming Psyllid. This has not previously been reported and has not yet been identified.

2. Agronomic Investigations.

A small variety and spacing experiment on rambutans has been laid down on the Kuala Kangsar Agricultural Station using three varieties and three different spacings within rows. Early casualties have been high.

Very good quality fruit is being harvested from a small manurial observation on Italian limes in Kuala Lumpur. On this particular soil the following fertiliser has given good results:—

1 part sulphate of ammonia
1 part double superphosphate
1 part sulphate of potash.

Livestock.

During the quarter, seven Middle White boars and six gilts were received in two shipments from the United Kingdom. Shortly after arrival of the second consignment three boars fell sick of suspected erysipelas but they have since recovered after being treated by the Veterinary Officer, Selangor. These animals have been imported in order to introduce new blood into Departmental herds and they will be used for feeding trials.

A fourth Bali calf was born to the Serdang breeding herd in November.

In the Serdang goat herd seven kids have been born and four old animals have died. The milk yield for the quarter totalled 4,208 lbs., with average daily yields ranging from 1.6 to 8.0 lbs. for pure-breds, from 1.0 to 5.9 lbs. for cross-breds, and from 1.0 to 1.9 lbs. for local animals.

In a goat feeding trial at Bukit Mertajam Agricultural Station, Province Wellesley, the first half-bred animal to be slaughtered reached a liveweight of 80 lbs. in twelve months and 90 lbs. in 14½ months.

NOTES ON EXTENSION WORK, OCTOBER TO DECEMBER, 1952.

Compiled by the Chief Field Officer.

Padi.

Manuring.

The State Agricultural Officer, Kelantan, reports that all officers of the Department not tied to experimental work have been largely engaged on giving instruction on the manuring of padi. The results have fully justified the time and effort expended; 4,959 1 cwt. bags of the manurial mixture have been sold. The advised rate of application is two bags per acre, and as it is believed that this rate is not usually exceeded the area manured is estimated to be 2,480 acres.

The policy has been to attempt to meet demand from distant areas and particularly those where little, if any, manure had previously been sent, with the object of making the effects of the manure known over as wide a field as possible. The demand has come for use of fertiliser on both the poor and the richer soils and the visual results have so far caused great satisfaction. In one notoriously low yielding area it is difficult to find a poor field. There have been reports from some areas that rats have been giving preferential attention to manured fields. This first season of commercial distribution promises to be highly successful, particularly when it is known that padi is grown mainly for consumption and is not a cash crop on any scale. Valuable experience has been gained, and it is obvious that the benefits of manuring padi are already established and that the demand is likely to grow in geometric progression for a period of years.

Mechanical Cultivation.

The first exploratory work on the introduction of mechanical cultivation into smallholding agriculture was done by the Department of Agriculture or by other Government Departments when, for example, tractors were sent to break new ground and hasten the development of new villages. The first commercial extension work was usually undertaken by the Rural & Industrial Development Authority, but in some areas the new village organisations managed the units of mechanical equipment. Private enterprise is now entering the field, and this should be a welcome and natural outcome of the preparatory work done by the several Government agencies. In Perak Central there are now 15 privately owned tractors operating on hire; in the Dindings, because of six privately owned tractors, R.I.D.A. has had some difficulty in getting enough work for its own tractors.

The following is a summary of the area cultivated during the quarter in the State of Perak by Departmental and R.I.D.A. tractors:

Perak North 113 acres, Perak Central 970 acres, Perak South 173 acres, Kinta 100 acres. Surveys of areas for their fitness for mechanical cultivation continue; in the Parit area a recent report shows that out of 3,729 acres surveyed 1,951 acres can be mechanised with light, wheeled tractors without modification.

In Selangor, a short operators' training course of four weeks was held at the Agricultural Station, Cheras. By invitation trainees were sent by other States.

Rubber.

During the quarter, 11,098 yards of budwood and 858,562 clonal seedling stumps were sold to smallholders under Colonial Development and Welfare Scheme No. D.1176.

The interim scheme for smallholders under the Rubber Industry (Replanting) Fund Ordinance, 1952, operated during the last quarter. The permanent Board with its own State Replanting Staff is expected to take over early in 1953.

In the meantime the Department is pressing forward with plans to provide sufficient high yielding planting material for the entire replanting target figure of 80,000 acres per year.

The interim scheme has been dealing with applications for the first part of the grant, which is paid for old rubber that has been felled and the land prepared for replanting, and in some areas the first payments have been authorised. The announcement of the Replanting Scheme has stimulated interest in replanting, but so far the indications are that the owners of medium-sized holdings are more actively interested than true smallholders with ten acres and under.

Fruit.

During the quarter, 3,377 budded fruit trees were sold from State and Settlement Agricultural Stations. The rambutan is in greatest demand and during the recent fruiting season fresh stocks of seedlings for budding have been laid down.

Livestock.

Pigs.

During the quarter, 99 Middle White boars and gilts were sold from Departmental centres.

New stud centres are being opened in new villages and there is an unsatisfied demand for pure-bred boars. Departmental herds are being increased and strengthened with the recent importations of new blood, and in addition private individuals now own breeding stock. The effect of this upgrading work is now very noticeable in many areas.

Poultry.

1,149 head of poultry and 1,478 hatching eggs were sold.

New Villages.

The Member for Agriculture and Forestry controls a fund that can be used for agricultural projects in the new villages. State and Settlement Agricultural Officers can therefore often secure prompt assistance for schemes that they sponsor. The schemes cover a very wide range of types of assistance to secure orderly development of the farm areas. They include stud boar centres, drainage, fencing against pests, small demonstration and extension agricultural stations, tractors and equipment.

General.

Many of the earliest and most important new villages have now settled down and the farming lands are under cultivation. This is having a noticeable effect on the supplies and prices of vegetables.

Civics courses for representatives from new villages have been held in both Selangor and Penang.

From the East Coast come reports of very active interest in fish ponds for tilapia. The State Agricultural Officer, Kelantan, reports that the construction of ponds goes on in all parts of Kelantan and opportunists are making high profits from the sale of fry; prices range from $50 per 100 for 1 in. fry to $250 per 100 for 3 in. fry.

Review

TEA PESTS AND DISEASES AND THEIR CONTROL

By Ernest Hainsworth. W. Heffer & Sons, Ltd. Pp. XI + 130, 32 plates.

Price 18s.

The title of this book is "Tea Pests and Diseases and their Control" with the sub-heading, shown on p.iii, "With special reference to North East India". In fact the book is almost entirely concerned with observations on pests and diseases and methods of control applicable to North East India, which seriously limits its usefulness in Malaya. Much of the book is thus inevitably taken up with the discussion of pests and diseases which do not occur or are rare in Malaya. In the case of diseases, examples of this are *Pythium* disease of seedlings, *Nectria* stem disease, *Macrophoma* branch canker, thorny stem blight, black rot and rim blight, while one of Malaya's most serious root diseases, red root disease (*Ganoderma pseudoferreum*) is not mentioned. Control methods suggested are not always suitable for Malayan conditions, e.g. those suggested for blister blight.

Similarly for pests, nearly four pages are devoted to the mosquito bug *Helopeltis theivora* Walk., but there is no mention of *H. cinchonae* Mann. or *H. bradyi* Waterh. both of which are serious pests of tea in Malaya where *H. theivora* does not occur.

The statement that *Helopeltis* lays its eggs "on the stalks of young leaves" is misleading and suggests that they are easily visible whereas they are, in fact, embedded in the stalk or shoot with only two, very fine, hair-like processes protruding.

The following errors in nomenclature were noted:—

p. 17. *Lachnosterna impressa* Burn. Burn. should read Burm. (Burmeister). This beetle should be placed in the genus *Holotrichia*, not *Lachnosterna*.

p. 18. The Cerambycid beetle *Xystrocera festiva* Thoms. is erroneously referred to as an Elaterid and is described as brilliant green in colour whereas, in point of fact, it is only the margins of the thorax and the costal margins of the elytra which are green. Whether the insect referred to is, in fact, *X.festiva* is another matter.

p. 79. The author of *Thosea cotesi* is Swinhoe, which by a printing error has been abbreviated as Swink.

p. 81. The genus *Belippa* should be *Cheromettia* for both species mentioned, and the remarkable statement that the larva of *lalaeana* Moore has no legs is incorrect. The legs of the larvae of all members of this genus are very small and inconspicuous, but they are nevertheless present.

p. 82. *Arbela quardinolata* appears for *A. quadrinotata* Walk. Both the Arbelids mentioned are referable to the genus *Indarbela*.

p. 83. By another printing error the author of *Acanthopsyche snellen* appears as the abbreviation Heye. instead of Heyl. for Heylaerts.

p. 89. No author is given for *Physothrips setiventris*.

p. 92. The generic name of the ant *Crematogaster* is given as *Cremastogaster*, which is perhaps excusable in view of the fact that Bingham uses the latter, incorrect name throughout in the *Fauna of British India*.

It would have been helpful if the families of the various pests mentioned had been given. Not all of the pests mentioned are likely to be known to workers outside India and citation of the family simplifies the turning up of other references.

Despite these shortcomings, there is much valuable information contained in the book. Sections dealing with control measures are sound and practical, and, if allowance is made for the different conditions in this country, should prove useful, as should the general discussion on pests and root diseases.

H.T.P. A.J.

Departmental Notes

We regret to record the death of Mr. Tan Bok How, a Major Scholar in the third year of the Diploma Course at the College of Agriculture. He died as the result of illness in the General Hospital, Kuala Lumpur, on the 1st November, 1952, and was buried at the Hokkien Chinese Cemetery in Bellamy Road.

He was born on the 16th August,1930, and his home was in Kuala Lumpur. His education prior to coming to the College was obtained at the Victoria Institution, Kuala Lumpur. He was awarded a Federal Major Agricultural Scholarship in June, 1950.

He was a pleasant, likeable young man, with a good all-round record, and popular with his fellow-students. He captained the College Badminton Team.

New Year Honours.

Mr. Lau Seng Nam, Agricultural Assistant, and Enche Abdul Rahman bin Rasib, Agricultural Subordinate Special Grade, have been awarded the British Empire Medal for meritorious service.

Mr. Lau Seng Nam is stationed in Selangor and Enche Abdul Rahman was invalided from the service in April, 1952.

Appointments.

The Right Honourable the Secretary of State for the Colonies has appointed Mr. A. R. McWalter to be a Soils Chemist in the Malayan Agricultural Service with effect from 29th November, 1952. Mr.McWalter arrived on the 17th December and is stationed at Headquarters.

Mr. R. G. H. Wilshaw, Chief Research Officer, has been appointed to act as Chief Registration Officer, Federation of Malaya, with effect from 14th October, 1952.

Mr. L. N. H. Larter, Botanist, has been appointed to act as Chief Research Officer with effect from 5th December, 1952.

Mr. E. A. Rosenquist, Botanist, has been appointed to act as Senior Botanist with effect from 5th December, 1952.

Re-instatement.

Mr. Gunn Lay Teik, O.B.E., Chemist, who retired on the 30th August, 1951, was reinstated in the service with effect from 1st January, 1952.

Promotion.

The Right Honourable the Secretary of State for the Colonies has approved the promotion of Mr. Gunn Lay Teik, O.B.E., Chemist, to be Senior Chemist with effect from 1st January, 1952.

Transfer.

Mr. J. R. Milburn, Agricultural Officer, assumed duty in the post of Settlement Agricultural Officer, Penang, with effect from 4th October, 1952.

Leave.

The following officers have returned from leave:—

Mr. O. J. Voelcker, C.B.E., Director of Agriculture, on 22nd October, 1952.

Mr. H. J. Simpson, Senior Agricultural Officer, on 29th October, 1952. Mr. Simpson has assumed duty as State Agricultural Officer, Perak.

Mr. E. A. Rosenquist, Botanist, on 13th November, 1952.

The following officers have proceeded on leave:—

Mr. H. D. Matheson, Agricultural Officer, on 4th October, 1952.

Mr. A. L. Barcroft, Agricultural Officer, on 12th November, 1952.

Mr. R. B. Jagoe, Senior Botanist, on 7th December, 1952.

Mr. D. W. M. Haynes, Agricultural Engineer, on 19th December, 1952.

Statistical

MARKET PRICES

October to December, 1952.

Rubber.—After a decline in October the average monthly Singapore price of No. 1 R.S.S., f.o.b., in bales increased in December to 90.76 cents per lb., the highest average monthly price since April, 1952.

On the 1st October the price was 74⅞ cents and there was little change until the 25th when the price reached 77¾. The month closed with the price at 77 cents giving an average for October of 75.32 cents per lb., the lowest average monthly price since 1950.

In November the price increased from 77½ cents on the 1st to 86½ on the 22nd, and then again to 91⅛ on the 29th. The average price for November was 82.8 cents per lb.

After a decline in the early part of December the price increased to 98¼ on the 10th but had fallen back to 83½ cents on the 17th. At the end of the month the price had reached 93⅜ cents per lb.

The average prices paid for smallholders' rubber at three centres in the Federation of Malaya during the last quarter of 1952 are given in Table I.

Table I.

Average Monthly Prices Paid by Local Dealers for Smallholders' Rubber, October to December, 1952.

(Dollars per picul of 133 1/3 lbs.)

Grades.	Taiping, Perak.			Seremban, Negri Sembilan.			Batu Pahat, Johore.		
	Oct.	Nov.	Dec.	Oct.	Nov.	Dec.	Oct.	Nov.	Dec.
Smoked Sheet	82.73	92.06	98.90	82.77	91.46	99.42	—	—	—
Unsmoked Sheet	57.32	68.10	75.34	58.50	64.90	73.84	62.85	71.56	80.17
Scrap	33.62	40.93	45.58	33.44	42.19	51.27	25.56	36.12	31.46

This Table has been compiled from statistics supplied by the Registrar of Statistics, Federation of Malaya.

Tea.—The average price paid in Colombo on the 17th November, 1952, for 22,215 lbs. of Malayan tea was Rs. 1.37 per lb. The average prices of Ceylon teas sold on that day were as follows, in rupees per lb.: High Grown Teas 2.21, Medium Grown Teas 1.78, Low Grown Teas 1.51.

Ceylon teas are subject to an export duty but non-Ceylon teas sold at auctions ex-bond in Colombo are not subject to this duty.

The above information is taken from the weekly report of the Colombo Brokers' Association.

In a return published by the Acting Registrar of Statistics, production of made tea in the Federation of Malaya, as declared by estates, during the 3rd quarter of 1952 was given as 887,731 lbs. green and 41,571 lbs. black teas.

Derris.—The average price of this commodity, as quoted in the weekly reports of the Singapore Chamber of Commerce, ranged from $125 to $145 per picul in October, $135 to $140 in November, and $145 to $150 in December.

Rice.—The ration is 3½ katis of Government imported and 1½ katis commercially imported rice per adult per week. The range of retail prices, in cents per kati, of the four grades of rice are as follows:—Best Siamese Grade 38 to 40, High Grade 32 to 36, Medium Grade 26 to 32 and Low Grade 19 to 21.

Table II.

Singapore Prices of Various Agricultural Products.

(Dollars per picul)

Date	Copra, Sundried	Coconut oil*	Pepper, F.A.Q. Muntok white	Pepper, Gen. Muntok white	Gambier, Cube	Sago Flour, Lingga	Tapioca Flour No. 1	Oilcake, Round
1952								
6th Oct. -	28.50	46.00	590.00	600.00	74.00	18.00	33.50	16.00
13th Oct. -	30.75	52.00	585.00	595.00	74.00	18.00	31.00	16.50
20th Oct. -	33.75	52.50	595.00	605.00	75.00	17.50	31.00	15.00
27th Oct. -	36.50	55.00	590.00	600.00	75.00	17.25	31.00	16.00
3rd Nov. -	34.00	54.00	570.00	580.00	75.00	17.25	31.00	18.00
10th Nov. -	36.50	56.50	555.00	565.00	75.00	17.25	30.00	18.00
17th Nov. -	35.50	54.00	540.00	550.00	75.00	17.25	30.00	17.50
24th Nov. -	33.50	52.50	540.00	550.00	80.00	17.50	29.00	17.00
1st Dec. -	33.25	52.00	545.00	555.00	80.00	18.00	29.00	17.00
8th Dec. -	33.25	53.00	545.00	555.00	85.00	18.00	28.50	17.00
15th Dec. -	35.25	55.00	550.00	560.00	85.00	18.00	28.50	17.50
22nd Dec. -	37.00	59.00	540.00	550.00	85.00	18.00	30.00	18.00
29th Dec. -	39.50	60.00	535.00	545.00	85.00	17.75	30.00	18.00

* F.O.B.

The above prices are taken from the weekly reports of the Singapore Chamber of Commerce.

FEDERATION OF MALAYA
PRODUCTION OF PALM OIL AND KERNELS.

(In long tons as declared by Estates)

Month	Palm Oil		Palm Kernels	
	1951	1952	1951	1952
January	4,068	3,182	997	839
February	3,510	3,110	813	850
March	3,821	3,327	940	865
April	3,732	3,350	896	893
May	4,260	3,076	1,029	793
June	3,295	3,020	801	718
July	3,249	3,988	781	959
August	3,913	3,819	946	931
September	4,614	4,044	1,125	983
October	4,854	4,265	1,172	1,066
November	4,495	4,797	1,151	1,176
December	4,463	5,117	1,120	1,175
Total	48,274	45,095	11,771	11,248

In December, 44 estates (planted area 93,743 acres) were in production out of a total of 52 oil palm estates (planted area 98,610 acres).

MALAYAN AGRICULTURAL EXPORTS, JULY-SEPTEMBER, 1952.

Product	Net Exports in Tons.			
	Year 1950	Year 1951	July-Sept., 1951	July-Sept., 1952
Arecanuts	14,867	13,547	2,066	410 ‡
Coconuts, fresh †‡	36,917 †	32,540 †	7,709 †	20,115 †
Coconut oil ‡	56,045	68,139	19,714	14,093
Copra ‡	4,778	10,878 *	9,715 *	5,060
Copra cake	31,105 *	37,891 *	10,523 *	17,316
Gambier, all kinds	331	36	56 *	40 ‡
Palm Kernels	9,070	11,809	2,555	2,254
Palm Oil	50,638	45,022	9,355	10,614
Pineapples, canned	14,666	16,859	4,234	3,595
Rubber ¶	692,585 ¶	603,880 ¶	147,239 ¶	148,820 ¶
Sago,—flour	12,006	28,044	8,862	4,114
„ —pearl	1,665	3,401	702	1,186
„ —raw	15,693 *	27,603 *	6,768 *	5,560
Tapioca,—flake	1,098	462	22	35
„ —flour	2,782 *	4,475 *	498 *	599
„ —pearl	13,507	10,230	2,147	1,578
Derris	44	56	13	3
‡ Copra equivalent	96,589	100,499	22,474	18,243

¶ production (Federation of Malaya). † hundreds in number. ‡ net imports.

FEDERATION OF MALAYA RUBBER PRODUCTION.

(In long tons, dry weight)

Month	Estates		Smallholdings (Estimated)		Total	
	1951	1952	1951	1952	1951	1952
January	29,482	27,044	26,588	23,770	56,070	50,814
February	26,519	24,007	22,468	19,200	48,987	43,207
March	30,591	25,679	28,000	20,810	58,591	46,489
April	24,470	25,533	22,005	19,065	46,475	44,598
May	24,227	27,362	20,124	18,346	44,351	45,708
June	28,141	27,243	24,498	20,333	52,639	47,576
July	27,286	29,473	21,097	20,299	48,383	49,772
August	27,330	28,301	24,500	22,052	51,830	50,353
September	26,293	28,690	20,733	20,005	47,026	48,695
October	27,622	29,369	22,509	18,856	50,131	48,225
November	26,690	31,827	20,502	18,855	47,192	50,682
December	29,305	33,800	22,900	22,727	52,205	56,527
Total	327,956	338,328	275,924	244,318	603,880	582,646
Total 1950	375,853		316,732		692,585	

This Table has been compiled from statistics published by the Registrar of Statistics, Federation of Malaya.

Smallholding production is estimated from purchases reported by dealers.

Many estates have revised their production figures as a result of enquiries made in connection with returns made under the Rubber Industry (Replanting) Fund Ordinance, 1952. This additional production covers the period January to November, 1952, and has been added to November estate production.

FEDERATION OF MALAYA

PRODUCTION OF COPRA, COCONUT OIL AND COPRA CAKE.

(in tons)

Month	Copra Production						Coconut Oil Production		Copra Cake (Poonac) Manufactured	
	Estates		Smallholdings (estimated)		Total		Oil Mills		Oil Mills	
	1951	1952	1951	1952	1951	1952	1951	1952	1951	1952
January	2,346	2,740	8,501	9,296	10,847	12,036	5,537	6,681	3,532	4,244
February	2,516	2,777	6,323	8,510	8,839	11,287	4,856	6,338	3,072	4,016
March	3,059	2,864	9,078	8,522	12,137	11,386	5,752	5,616	3,784	3,647
April	2,888	2,964	7,832	8,684	10,720	11,648	5,714	6,128	3,585	3,949
May	3,200	3,279	10,764	8,560	13,964	11,839	6,718	5,797	4,342	3,820
June	3,692	3,643	9,518	7,642	13,210	11,285	7,287	6,067	4,716	3,960
July	4,083	3,846	11,580	11,294	15,663	15,140	8,571	7,177	5,567	4,075
August	4,044	4,151	11,756	10,357	15,800	14,508	8,552	7,645	5,569	4,902
September	3,777	3,848	10,551	12,426	14,328	16,274	7,833	8,292	5,043	5,014
October	3,402	3,358	12,186	10,757	15,588	14,115	8,543	7,622	5,570	4,981
November	3,245	3,103	10,392	9,569	13,637	12,672	8,491	7,214	5,456	4,695
December	3,170	2,950	12,139	9,225	15,309	12,175	8,543	6,608	5,425	4,278
Total	39,422	39,523	120,620	114,842	160,042	154,365	86,397	81,185	55,661	51,581

Notes:—1. The above statistics are compiled and published by the Registrar of Statistics, Federation of Malaya.

2. Estate copra production and coconut oil production are as declared by estates and oil mills respectively.

3. Statistics of smallholding coconut oil production are not available.

4. Smallholding copra production for commercial purposes is estimated from the formula: imports + estate stocks (opening) + estate production + smallholding production = exports + local oil mill consumption + estate stocks (closing).

METEOROLOGICAL SUMMARY, MALAYA, SEPTEMBER, 1952.

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes									Number of days							
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F	Total		Most in a day Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
										ins.	mm.	ins.						hrs.	hrs.	
Ipoh, Perak	91.4	72.1	81.7	97.0	69.7	86.4	75.0			4.97	126.2	1.30	18	14	3		2			
Port Swettenham, Selangor	88.4	71.9	80.1	92.3	69.0	81.8	74.8	84.2	85.2	17.54	445.5	2.73	18	17	1			205.20	6.84	
Kuala Lumpur, Selangor	89.6	72.2	80.9	93.9	69.0	83.7	74.0			8.50	215.9	3.78	13	9	4	1				
Sitiawan, Perak	90.0	72.6	81.3	93.4	69.2	82.3	74.8	85.2	86.5	8.74	222.0	3.44	13	9	4			201.45	6.71	
Kuala Lipis, Pahang	89.4	71.3	80.3	92.1	68.7	82.2	73.6	84.2	84.7	5.57	141.5	1.49	14	14	7	27		181.40	6.05	
Kuantan, Pahang	89.6	71.3	80.5	91.9	68.9	83.1	73.6			5.50	139.7	2.62	16	14	7	5		184.75	6.49	
Temerloh, Pahang	89.8	71.9	80.9	92.4	69.0	84.0	74.0			8.61	218.7	2.40	18	16	8	8		195.75	6.53	
Bayan Lepas, Penang	87.0	74.1	80.5	90.1	70.4	80.4	76.2			10.91	277.1	2.86	19	16	1			175.95	5.87	
Malacca	85.2	72.9	79.1	87.8	69.7	80.9	75.6			8.67	220.2	2.98	16	12	1		6	210.10	7.00	
Mersing, Johore	88.4	71.0	79.7	91.4	69.6	84.4	73.1			8.02	203.7	2.85	15	15	9		2	218.10	7.27	
Alor Star, Kedah	87.6	73.2	80.4	91.4	70.6	82.7	75.0			7.04	178.8	2.50	14	11	1			178.55	5.95	
Kota Bharu, Kelantan	88.2	73.5	80.9	93.2	70.2	82.2	75.2	87.4		4.16	105.7	1.48	16	12	6	1		213.55	7.12	
K. Trengganu, Trengganu	86.9	72.3	79.6	89.2	70.2	82.1	74.8			11.45	290.8	3.56	14	13	2			196.30	6.54	
Kallang Aerodrome (S'pore)	87.4	76.0	81.7	89.9	73.2	82.4	80.3			3.94	100.1	1.40	13	10	3		2	197.25	6.57	
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	73.4	61.6	67.5	77.2	58.4	69.3	64.2	72.2	72.7	9.08	230.6	1.63	18	18	4	18		177.00	5.90	
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	72.8	55.2	64.0	76.4	50.8	68.8	60.8	69.3	70.0	7.37	187.2	2.11	16	16				140.15	4.67	

Compiled from Returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, OCTOBER, 1952.

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes									Number of days							
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F	Total		Most in a day Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
										ins.	m m.	ins.						hrs.	hrs.	
Ipoh, Perak	90.4	72.5	81.5	93.8	70.4	84.0	75.0			8.80	223.5	2.67	18	16	1			179.45	5.79	
Port Swettenham, Selangor	88.9	73.2	81.1	92.0	71.3	84.0	74.9	85.2	84.8	3.99	101.3	1.35	17	10				183.90	5.93	
Kuala Lumpur, Selangor	89.9	73.1	81.5	94.0	70.4	84.0	75.2			5.88	149.4	1.96	16	14	4	1				
Sitiawan, Perak	89.5	72.8	81.1	92.0	70.2	85.5	74.4	85.1	86.1	2.38	60.5	0.88	15	12				182.75	5.89	
Kuala Lipis, Pahang	89.1	71.7	80.4	92.0	69.3	81.3	73.6	83.5	84.4	14.51	368.6	2.93	16	21	7	30		149.10	4.81	
Kuantan, Pahang	88.5	71.8	80.1	92.3	69.1	78.3	74.6			11.89	302.0	2.81	21	15	4	2		158.05	5.10	
Temerloh, Pahang																				
Bayan Lepas, Penang	86.3	74.7	80.5	90.0	72.4	76.0	77.0			19.27	489.5	6.23	19	17	1					
Malacca	85.7	74.2	79.9	88.0	71.7	80.8	78.0			5.91	150.1	2.63	13	11	1		2	199.65	6.44	
Mersing, Johore	87.5	72.2	79.9	93.8	69.9	76.8	73.6			9.58	243.3	1.92	22	19	5		2	175.20	5.65	
Alor Star, Kedah	86.7	73.7	80.2	90.8	71.0	79.3	76.2			12.51	317.8	2.70	16	15				155.25	5.01	
Kota Bharu, Kelantan	87.8	73.8	80.8	90.5	72.1	80.5	75.6	85.7		7.62	193.5	2.49	20	16	1			181.40	5.85	
K. Trengganu, Trengganu	86.7	72.9	79.8	88.2	71.2	82.0	74.5			9.65	245.1	2.28	22	22	5	2		169.45	5.47	
Kallang Aerodrome (S'pore)	87.1	75.1	81.1	90.8	69.0	77.0	78.2			12.20	309.9	3.60	21	17	3		2	182.85	5.90	
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	73.3	62.3	67.8	77.7	59.7	68.2	64.3	72.2	72.5	9.25	235.0	1.96	21	19	3	12		134.20	4.33	
Cameron Highlands, Tanah Rata, Pahang 4750 ft.		58.0			51.4		61.8			9.06	230.1	1.40	24	22				129.05	4.16	

Compiled from Returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, NOVEMBER, 1952.

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Sunshine Bright		
	Means of			Absolute Extremes									Number of days							
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 foot °F	Total	Most in a day Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
										ins.	m.m.	ins.						hr.	hr.	
Ipoh, Perak	89.2	72.2	80.7	92.4	70.6	84.8	74.0			16.51	419.4	2.80	26	20	8			131.65	4.39	
Port Swettenham, Selangor	87.2	72.5	79.9	91.0	69.0	82.3	75.3	84.0	85.1	10.55	268.0	2.68	18	15				126.30	4.21	
Kuala Lumpur, Selangor	89.1	72.5	80.8	92.4	69.8	85.1	75.3			6.63	168.4	2.36	24	21	5	3				
Sitiawan, Perak	88.1	72.5	80.3	91.8	70.4	85.2	74.0	83.9	85.5	10.40	264.2	3.08	18	12	2			142.00	4.73	
Kuala Lipis, Pahang	87.0	71.4	79.2	90.4	69.0	80.0	73.2	82.3	83.8	14.20	360.7	2.92	26	27	5	29		106.10	3.54	
Kuantan, Pahang	85.3	71.7	78.5	90.0	69.3	77.7	74.0			11.59	294.4	1.67	21	18	4	5		83.65	2.79	
Temerloh, Pahang	86.6	72.3	79.5	89.4	70.0	80.0	74.4			12.95	328.9	3.10	22	21	6	6		113.25	3.77	
Bayan Lepas, Penang	85.7	73.7	79.7	89.4	71.0	81.0	76.0			16.17	410.7	4.39	22	17	2			122.35	4.08	
Malacca	85.9	72.7	79.3	90.0	70.4	82.3	75.1			7.71	195.8	1.51	18	14	3		2	152.50	5.08	
Mersing, Johore	84.5	72.4	78.5	87.9	70.4	78.1	77.4			10.58	268.7	2.19	25	22	2			96.50	3.22	
Alor Star, Kedah	86.9	72.3	79.6	91.6	68.7	81.8	74.8			11.69	296.9	3.76	22	18	1			128.45	4.28	
Kota Bharu, Kelantan	83.2	73.2	78.2	88.0	71.8	75.1	75.2	82.1		16.29	413.8	3.20	23	22	1			123.10	4.10	
K. Trengganu, Trengganu	82.7	72.7	77.7	86.8	67.2	75.9	76.5			15.28	388.1	2.95	23	20		1		99.05	3.30	
Kallang Aerodrome (S'pore)	86.6	73.9	80.3	90.9	71.4	81.3	76.0			11.46	291.1	3.17	20	20	5		1	117.00	3.90	
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	71.9	61.8	66.9	75.2	58.8	66.9	63.1	71.6	72.2	16.18	411.0	1.60	26	26	2	16		73.70	2.46	
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	71.7	58.3	65.0	75.4	54.2	66.4	61.2			15.64	397.3	1.90	27	23						

Compiled from Returns supplied by the Malayan Meteorological Service.